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# Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

*Editorial Office:* 1102 16th Street, N. W., Washington 6, D. C.

VOLUME XL NO. 3

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**Typically March!**

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***Twenty years ago we had . . .***

# Soil-conserving Goals

Jeff McDermid

(Elwood R. McIntyre)

DEBATE pro and con respecting the proposed soil bank legislation stirs memories of similar agitation and great expectations in the spring of 1936. Early in January 1936, fellows who had spent long overtime hours trying to make the Agricultural Adjustment Act of 1933 workable and popular received a rough solar plexus punch when the Supreme Court outlawed the processing tax on domestic processing of basic food commodities. Without that revenue it meant that benefits to cooperating producers were "kaput" leaving no way for the government to stabilize the acreage of basic crops through compensation payments.

Far afield in the state and county offices of the AAA personnel the closing days of January 1936 were gloomy and distraught. Extension Service agents were likewise stymied in their main piece of current educational effort by the legal blow. But the center of the deepest murk of misery was in the once bustling halls of the mammoth buildings on the historic Mall, between 12th and 14th Streets, S. W., where refugees from the Great Depression had secured temporary employment under such farm leaders of the times as George Peek, Chester Davis, Rex Tugwell, Milburn L. Wilson, Charles Brand, and Henry A. Wallace.

For over three years those stately buildings were a beehive. Scientific research went forward, it is true, but played second fiddle in the then improvising orchestra directed by composers who sought to create a score that would blend the gaiety of Gilbert

& Sullivan with the triumphant and majestic airs of Handel and Wagner. Their immediate job was to set up something strong enough to last, fair enough to be acceptable, and conservative enough to unite all factions. With the basic crops, their objective had been relatively successful, although the milk license dilemma was giving them the willies.

At that time the Department was the center of attention and conjecture because everybody wondered what the next move of the New Dealers would be—how they could find a substitute for the processing tax and carry on in the reduction of excess plantings of basic crops without such financial backlog. They had counted on the processing tax. They often said that it was a sort of protective tariff for the farmer to insure consumers a reasonably priced and adequate food supply.

AS always in times of crises, the alert and inquisitive press rallied around the ramparts. In 1936 we had the usual quota of news sleuths pounding their machines in a little office assigned to correspondents on the third floor of the Administration Building. At such times there are a select few of the profession who dig deeply and think hard, who pose noxious questions that division chiefs dodge if they can, and whose stories ring the bell with an astounding insight into the gist of backstage conferences not supposed to include the reporters.

Two of the prominent and farsighted reporters of that era in Washington who were regularly assigned to the Department were J. R. Wiggins, representing one of the wire services, and Felix Belair, "New York Times." Few readers ever heard of these men in connection with agriculture, but they were astute and well informed, and actually had a hand in promoting the legislation enacted in 1936, known as the Soil Conservation and Domestic Allotment Act. This is how it happened—and I have checked back with Mr. Wiggins, now manager of the famous "Washington Post and Times Herald."

It usually happens that regularly assigned reporters get so well acquainted with the aims of a given program and its value that they often become sold on the thing. They don't let their bias interfere with their neutral statements as news writers, but personally some of them are keen defenders of farm legislation of the sound kind, believe it is just, and do all they can to promote it by exposing half-truths and misrepresentations. Of course, sometimes you meet up with the reverse in reporters—chaps whose jobs depend on doing all they can to ridicule and hamstring any current policies in our farm laws. In the case of J. R. Wiggins, he had a rural background and a real knowledge of the farm economy, as he was from the "Pioneer Press-Dispatch of St. Paul."

SO, during relatively idle hours, these two writers and curious hunters for topics were discussing the prospects for the AAA to get out of the legal cul-de-sac where the court decision had landed it. Together they thought of the recently enacted Soil Conservation Act, set up in 1935, with Hugh Bennett as the chief of what has become the Soil Conservation Service. What about that new outfit? Might it be susceptible to amendment so as to modify its purposes a trifle? They got a copy of the law in question and pored over it together for a day or so. Finally, they concluded that its terms and purposes could well be modified so as to permit making direct cash payments to farmers on a general basis of soil improvement instead of on a project basis, as with the AAA.

They knocked hard on Chester Davis's besieged door and he let them in as old friends who had always treated the AAA fairly. When he heard the "line" of attack to the current dilemma outlined by Wiggins and Belair, he summoned several of his assistants. They all thought something like this could be done. Right soon it was taken up with Secretary Wallace and eventually the draft of a new act was introduced in Congress. While it did not

follow exactly the ideas of the two alert reporters, it was an adaptation of them. At the outset, Hugh Bennett was a bit fearful of the consequences insofar as the S.C.S. was concerned, but he saw its practical value and the opportunity it carried to continue benefit payments under a safer and saner objective of soil improvement and conservation.

MANY readers are not aware that the provisions of the same Soil Conservation and Domestic Allotment Act are still on the U. S. law books,

including the plan for payments to producers for cutting acreage of soil-depleting crops, which are mainly our basic crops troubled more or less with burdensome surpluses. Not since 1943 have such payments been made. What remains of the law in active practice is that part relating to payments to establish certain approved soil conservation methods, fertilizing, liming, terracing, contouring, pond building, weed killing, and the like.

Under the original AAA, soil saving and fertility had been a secondary issue to the main problem of getting cash on the barrel head out to the distressed farmers. But under the new law of 1936, the primary goal was to discourage large acreages in corn, wheat, and cotton and replace them with a list of approved conserving crops and "go-down" crops for green manuring. In reality it never got very attractive sums to the farmers in comparison to the great amount of reckoning and pull-hauling that had to be done before audiences of farmers who wanted to know what to do and how to get paid for it. I have some old notebooks by my side filled with "examples" of soil-depleting and soil-conserving bases, and perhaps that's what we are running into with the forthcoming soil bank plan.

The Soil Conservation and Domestic Allotment Act in amended form is still in effect, but in its changed form it does not run afoul of the duplication and competition with the S.C.S. that we had back when it was administered by the AAA in the period from 1936 to 1943—when benefit payments were made for checking erosion and building up soils. But legislative authority still exists for both types of payments—for shifting acreage from soil-depleting to soil-conserving crops, and the current payments for definite soil-conserving practices by the Agricultural Conservation Program.

IN the original times after the 1936 law had been put into force, there was considerable friction between the S.C.S. field people and the AAA over these direct payments for removal of depleting acreages because they did not always jibe with the recommendations and experience of the soil conservationists. Minor differences occurred between the S.C.S. and the extension staffs, but such divergent views are not what I set out to talk about—so let's skip them!

I'd like to set down some of the pronouncements and beliefs that accompanied the enforcement of the provisions of the Soil Conservation and Domestic Allotment Act—the real birth of which was in the mind of the late Dr. Spellman who was a pioneer thinker on farm programs. I am dipping back into certain circulars that the AAA administrators issued in 1936-37 wherein the basic thinking behind the movement is revealed.

It was declared that a land-use program would help solve the immediate problem of balancing farm production with effective demand. To check soil

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# The Application of Fertilizers in Irrigation Water

*By H. D. Chapman*

Department of Soils and Plant Nutrition, University of California, Citrus Experiment Station, Riverside, California

THE practice of applying fertilizers in irrigation water has grown rapidly since World War II. With the enormous expansion of irrigation agriculture throughout the world, interest in this method of applying fertilizers has increased greatly. A considerable number of questions naturally arise—among them, the kinds of fertilizer suitable and available, the mechanics involved, corrosion problems, uniformity of distribution, rates of application, and efficiency.

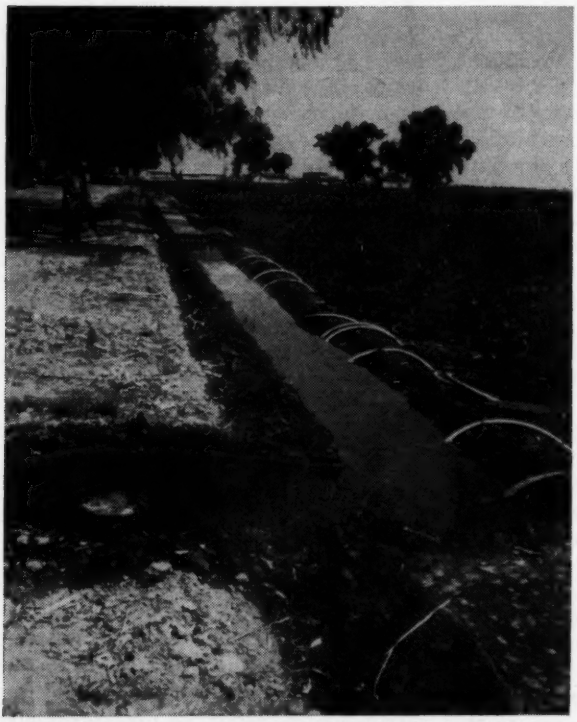

**Fig. 1. Irrigation of sweet corn in Coachella Valley, California. Water is emerging from submerged valve in foreground left and is conducted by open ditch along edge of field. Plastic siphons carry water into furrows. Fertilizer solutions or dry materials are added at water source.**

### Kinds of Fertilizer

Both liquid and dry fertilizers are being widely used for irrigation water application. According to the 1953 report of the Bureau of Chemistry of the State of California (Special Report No. 251) there were 82 different companies or registrants selling one or more forms of liquid fertilizer in California during the period covered by the report. These were sold under some 238 different brand names, and can be classified as follows:

1—Liquid fertilizers containing nitrogen, phosphoric acid, and potash,

2—Liquid fertilizers containing nitrogen and phosphorus,

3—Liquid fertilizers containing nitrogen and potash,

4—Anhydrous ammonia,

5—Aqua ammonia,

6—Ammonia — ammonium nitrate solutions,

7—Ammonium nitrate solutions,

8—Urea solutions,

9—Liquid fertilizers containing phosphoric acid and potash,

10—Liquid phosphoric acid,

11—Miscellaneous liquid fertilizers.

In Table I is shown a small sample of typical analyses of some of the various kinds of fertilizers on the market.

In addition to the nitrogen- and/or phosphorus-potash-containing fertilizers, some carry guaranteed amounts of other elements such as iron, zinc, manganese, magnesium, calcium, and sulfide sulphur.

A considerable number of liquid fertilizers made from fish refuse and containing nitrogen, phosphorus, and potash in amounts ranging from 1 to 12% nitrogen and from 1 to 5 or 6% available phosphoric acid and potash are among the various labeled brands.

**Fig. 2. Dry, bagged material is commonly dumped into irrigation weirs and thus flows through distributing system and furrows.**

Among the principal ingredients used to compound these various simple or mixed liquid fertilizers are anhydrous ammonia, ammonium nitrate, urea, phosphoric acid, potassium sulfate, and fish wastes.

TABLE I.—EXAMPLES OF KINDS AND ANALYSES OF SOME LIQUID FERTILIZERS SOLD IN CALIFORNIA. (TAKEN FROM STATE OF CALIFORNIA BUREAU OF CHEMISTRY SPECIAL REPORT 251. 1953).

| Designation | Nitrogen | | | | Phosphoric acid available % | Water-soluble potash % | Chlorine % | Density lbs/gal. |
|---|---|---|---|---|---|---|---|---|
| | Nitric % | Ammonia % | Organic % | Total % | | | | |
| 1 | ..... | ..... | 15.43 | ..... | 5.06 | 8.19 | 6.80 | 10.72 |
| 2 | 5.03 | 5.05 | ..... | 10.08 | 10.17 | 4.94 | 4.30 | 10.84 |
| 3 | 11.90 | 27.94 | ..... | 39.84 | ..... | ..... | ..... | 9.16 |
| 4 | ..... | ..... | 9.76 | ..... | 3.34 | 4.33 | 2.10 | 9.76 |
| 5 | ..... | ..... | 22.52 | 22.52 | ..... | ..... | ..... | 9.59 |
| 6 | ..... | ..... | 3.29 | 3.29 | 2.95 | 1.11 | 0.05 | 9.01 |
| 7 | ..... | ..... | 10.37 | 10.37 | 3.26 | 1.19 | 0.10 | 9.34 |
| 8 | 8.03 | 7.38 | ..... | 15.41 | 8.27 | 4.13 | 2.40 | 11.25 |
| 9 | ..... | ..... | 12.16 | 12.16 | 5.07 | 5.02 | ..... | 9.80 |
| 10 | 9.95 | 9.95 | ..... | 19.90 | ..... | ..... | ..... | 10.51 |
| 11 | ..... | ..... | ..... | ..... | 52.67 | ..... | ..... | 13.89 |
| 12 | 0.96 | 1.36 | 2.01 | 4.33 | 8.08 | 9.85 | 6.80 | 10.25 |

**Fig. 3. This illustrates system of delivering liquid fertilizers in tanks to irrigation source where it is discharged into water supply.**

The actual tonnage of liquid fertilizers sold in California is not known currently, but it has shown a spectacular increase in recent years. In addition to the various labeled liquid mixes sold under many different brand names, very substantial tonnages of dry fertilizers—calcium nitrate, ammonium nitrate, and urea—are bought in dry form and applied to irrigation water by various means.

For a time, liquid fertilizer mixes were somewhat in disrepute owing to the fact that prices charged for them were considerably above those of the actual plant foods contained therein. However, this situation has changed due to competition, on the one hand, and recognition that there is nothing special or mysterious about this form of fertilizer. Convenience of application and better control and economy are among the principal advantages.

### Methods of Application

A considerable number of application methods are used for liquid and dry fertilizers applied to irrigation waters. With bagged dry material, it is not an uncommon practice to either slit the bags and throw them one by one into a weir box or similar structure, or else dump the contents into same. The rate of solution can to some degree be controlled by varying the size and number of slits in the bag. Though this is a very crude method, it is used quite extensively with citrus, and to date the author has seen no damage to trees from this method. No studies have been made, however, of the uniformity of distribution.

The more widely used methods for both solid- and liquid-fertilizer application are tanks or barrels of varying sizes in which concentrated solutions of the fertilizers are made up or packaged and dispensed in the irrigation source by various devices. These tanks are of various kinds and sizes: woodstave, steel, aluminum, and concrete. Arrangements for delivering the concentrated stock solutions into the irrigation water range from simple wood spigots and simple siphons to other devices whereby the flow can be accurately regulated. In some cases a floating siphon supported by a broad float resting on the surface of the stock solution is used, and the flow regulated simply by adjusting the vertical distance

between the intake and outflow ends of the siphon. In other instances the stock solution flows into a separate container with float valve to maintain constant head, and flow is regulated from the secondary vessel by means of a rotatable curved open tube outlet which connects with the interior of the vessels through a packing gland, permitting the discharge rate to be varied by rotating the curved spigot.

In injecting fertilizer stock solutions into pressure lines, various pump arrangements are used.

The discharge of gaseous ammonia into irrigation water is effected by means of valves which permit the gas to flow through differently sized orifices, thus varying the rate of flow. The gas then flows through a flexible hose and is discharged into the irrigation water through a perforated metal end attached to the hose.

Some problems have arisen and some precautions are required in connection with fertilizer application to irrigation water.

The chief problem with the addition of ammonia gas to irrigation water is the precipitation of carbonates. This precipitate, if not controlled, will coat pipelines, valves, and gate openings on irrigation risers. Carbonate precipitation can be well controlled, however, by the addition of a solution of sodium hexametaphosphate. Where ammonia solutions are used, this compound is usually added to the aqua stock solution.

The use of ammonium sulfate in concrete should be avoided or, if it is used, the concentration kept below 0.1 per cent. The pipeline should be flushed after using this particular compound. On the other hand, sodium nitrate, calcium nitrate, ammonium nitrate (in concentrations up to 1.0 per cent), and liquid ammonia as ordinarily used have no effect, nor have other commercial fertilizers in so far as they have been tested. Pillsbury (3) has made special studies of the deterioration problem in

**Fig. 4. The oil drum on stand serves as container for concentrated stock solution of fertilizer. Rate of flow into water is regulated by simple clamp in outlet tube.**

concrete and recommends special precautions in the use of ammonium sulfate, or other sulfate-containing materials. A good practice is to be sure that all the fertilizer has been added prior to terminating an irrigation so that the whole system can be flushed with fertilizer-free irrigation water prior to concluding the irrigation.

### Uniformity of Distribution

***Furrow Irrigation***—The distribution of fertilizers in irrigation water will, in general, closely parallel the uniformity of water distribution. One of the defects of the furrow system of irrigation is that if sufficient water is used to thoroughly wet the requisite root zone depth at the end of the run, there will be excessive penetration at the upper end, and hence some leaching loss of fertilizer. However, this also will occur where soluble fertilizer is uniformly broadcast. Also, another problem is runoff loss, for, if sufficient water is run through the furrow to thoroughly wet the ends of the runs, there is bound to be a certain amount of runoff, and thus loss of fertilizer.

Another problem in furrow irrigation is that there is lateral seepage and capillary movement of water to the furrow crest where evaporation occurs, and hence deposition of salt and fertilizer. This has been well known for many years. Harding (2) has recently published the results of special studies of the character and quantities of such accumulations in a non-tilled orange orchard where salt had built up for several years. He found in the 0- to 1-inch layer of the surface crest, 3,040 milliequivalents per liter of salt in a saturation extract, of which 2,320 m.e. were nitrate. In the furrow bottoms conversely he found only 55 m.e. total salt and 5 m.e. of nitrate. Of course, these accumulations of fertilizer are not permanently lost, inasmuch as both lateral and vertical distribution occurs through cultivation, rainfall, and subsequent irrigation.

In connection with a study of losses of ammonia by volatilization when added to irrigation waters, field studies of the decrease in concentration of ammonia from the head to the furrow end were made. Sample data for a number of typical orchards are presented in Table II. These show that in traveling from 200 to 300 feet down the furrow, ammonia concentration decreased all the way from 0 to 50%, depending on the conditions which prevailed in the particular orchards studied. This decrease in concentration is due, both to fixation of $NH_4$ by the soil and volatilization loss, though the latter is the larger factor. In any case, it is evident that where there is a 30 to 50% decrease in concentration over a distance of 300 feet uniform distribution does not occur. However, as stated, there is more leaching at the upper end of the furrow; thus, greater need for fertilizer in this area. Hence, the uneven distribution of ammonia under furrow irrigation is in reality beneficial since leaching loss of nitrogen is compensated for by a greater deposit in this area.

***Sprinkler Irrigation***—While in theory sprinkler irrigation should result in a much more uniform distribution of fertilizer than by furrow method, this does not necessarily follow. In the first place, water is seldom, if ever, uniformly distributed over the soil surface by sprinklers and, in the second place, many sprinkled soils glaze over somewhat and the water then collects in minor depressions so that some soil areas receive much more water than others. Despite these defects in uniformity of distribution, there are advantages which outweigh them.

One of the main potential sources of trouble under sprinkler irrigation is that, in many instances, insufficient water is applied to effect deep water penetration and thus the flushing of the soil to remove salt. The author has seen a number of citrus groves recently where one section was sprinkler irrigated and an adjacent area furrow

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Fig. 1. Southern Regional Plant Introduction Station at the Georgia Experiment Station.

# Some Contributions of Recent Plant Introductions to Southern Agriculture

*By Edwin James* *

Regional Primary Plant Introduction Station, Experiment, Georgia

SINCE the first colonists settled on the North American Coast, plant introduction has been an integral part of our agricultural economy. They and their descendants laid bare the forest climax extending from the Mississippi River to the Atlantic Coast, turned under the native grasses of the prairies and the great plains, moving ever westward until they finally reached the Pacific Coast. This tremendous acreage became populated with the crops we know today: sugar cane, figs, dates, olives, alfalfa, and citrus fruits brought in by Spanish explorers; wheat, oats, barley, rye, cabbage, lettuce, and turnips which came in with the English colonists; and the extensive array of grasses and legumes originating in diverse areas throughout the world.

Not until 1819 was any effort made by the Federal Government to assist in this work. Steady growth in plant importation by various federal and state agencies finally led to what is now the Plant Introduction Section in the Agricultural Research Service of the U. S. Department of Agriculture.

Funds made available by the Research and Marketing Act of 1946 led

* Coordinator Regional Project S-9 "New Crops," Southern Regional Plant Introduction Station, Georgia Experiment Station, Experiment, Georgia. Cooperative with the Plant Introduction Section, ARS, USDA.

to the expansion of activities in plant exploration and introduction and to greater cooperation among the states in testing and evaluating the large numbers of introductions brought in under the expanded program. This enabling legislation led to the establishment of Regional Plant Introduction Stations in the four experiment station regions in the United States. These stations function as a part of a cooperative federal-state program.

The Regional Plant Introduction Station for the Southern States was established in November 1949 at the Georgia Agricultural Experiment Station, Experiment, Georgia. Since that time it has received from the Plant Introduction Section approximately 9,000 introductions. Distribution of 25,000 separate lots of seed has been made to cooperators in every state in the Southern Region.

When considering the fact that soybeans were first introduced in 1804, sericea lespedeza in 1896, and ladino clover in 1908, one would hardly expect new crops to be introduced and gain immediate acceptance. Research men, however, rely to a great extent on the disease resistance found in the numerous introductions for the improvement of new varieties. In most instances, germ plasm for the improvement of our crops must depend on foreign sources where the greatest genetic variation is found.

In the five-year period of the operation of the Southern Regional Plant Introduction Station, over 300 introductions have been reported to have value. Only a few, however, including some recent developments before the initiation of the cooperative program will be mentioned herein.

## Grass Introductions

### Bermudagrass, *Cynodon dactylon*

Bermudagrass is classed among those grasses that have been in the country so long that they are commonly thought to be native. It is, however, native to India and no record of its first introduction into this country can be ascertained. Certain evidence shows that it was familiar to the early colonists. In the South it has been cursed by the cotton farmer and blessed by the livestock man. Without question it may be considered the most important grass in the Southern States. Apparently little or no improvement in Bermuda-

**Fig. 2. Part of the grass introduction nursery at the Southern Regional Plant Introduction Station.**

grass was attained until the discovery of Tift Bermuda in 1929 near Tifton, Georgia, by J. L. Stephens of the Georgia Coastal Plain Experiment Station. In 1937 a hybridization program at that Station involving common Bermuda, Tift Bermuda, and two tall strains of Bermuda introduced from Africa, was initiated by G. W. Burton. From over 5,000 seedlings resulting from natural hybridization, 147 were selected in 1939 for further evaluation. One of these was so outstanding in so many characteristics that it was selected and named Coastal Bermuda. Coastal Bermuda is now so well known and so widely distributed in the South that a discussion of its merit is hardly needed.

A sister selection of Coastal Bermuda is less well known. This is the Suwanee, released by the Georgia Coastal Plain Experiment Station and the U. S. Department of Agriculture in 1954. This variety is similar in most respects to Coastal but does not stand other grass competition or close grazing as well as Coastal. It is superior to Coastal for the deep oak ridge sandy soils of the Coastal Plains.

The hybrid vigor of Coastal Bermuda is also reflected in Midland Bermuda, which was released jointly by the U. S. Department of Agriculture, the Georgia Coastal Plain Experiment Station, and the Oklahoma Agricultural Experiment Station in 1953. This variety is a cross between Coastal and an Indiana strain and is better adapted to the northern range of Bermudagrass where Coastal Bermuda is subject to winter injury. In addition to being winter-hardy it is resistant to drought and diseases, and has two to four times the production of common Bermuda.

### Bahiagrass, *Paspalum notatum*

Bahiagrass, although of secondary importance in the Southern States, is gradually being accepted as a valuable forage species. The first record of its being received in Florida as a Plant Introduction was in 1913.

Common Bahia, largely from Cuba, had been the prevailing source of seed until recent years, but lacked the hardiness required for a good pasture species. An introduction from South America in 1937, now recognized as Paraguay Bahia, has proved to be a valuable forage species. This accession is more frost-resistant and grows at lower tem-

**Fig. 3. "New Crops" Technical Committee inspecting grass nursery at the Southern Regional Plant Introduction Station.**

peratures than common. Another advantage of the Paraguay strain is the nonshattering quality of the seed heads, permitting greater yields of seed per acre. Like other species of Paspalum, it is susceptible to ergot.

However, an introduction from Paraguay in 1947 has the desirable qualities of former introductions with the added feature of being ergot-immune. Only 100 acres were planted with this introduction in 1954 but seed stock sufficient to seed 300-400 acres more has been obtained and is rapidly being distributed to Coastal Plain farmers for further tests. In yields of beef per acre it compares favorably at Tifton with Coastal Bermuda and appears superior in some respects to other Bahia strains.

Argentine Bahia, introduced in 1944 from Argentina, was recognized by G. E. Ritchey of the Florida Agricultural Experiment Station as having outstanding yield capabilities. Further tests indicated that under Florida conditions this grass was a high yielder among the Bahia strains.

The present acreage in Bahiagrass in the South is not definitely known but is estimated at 500,000 acres in Florida alone. This grass apparently has a place in the forage crop program on soils too poor for Coastal Bermuda, and is presently recommended for such situations.

### Buffelgrass, *Pennisetum ciliare*

Buffelgrass, a native of Africa, is a more recent immigrant attracting the attention of grass specialists. It was introduced into the United States as early as 1908 from India, where in the Coimbatore District it was widely grown for cattle pasture because of its valuable fodder and drought resistance. Several introductions followed the first, but none attracted attention until 1939 when an introduction was received from Pretoria, South Africa. This strain was designated in Texas as T-3782 by the Soil Conservation Service, and is now in commercial channels as blue buffelgrass. This is a rhizomatous type with light-colored seed heads and bluish-green foliage. It receives preference over T-4464, out of an introduction from Kenya, South Africa, which is a fibrous-rooted type with purple heads and bright green foliage. Buffelgrass is a highly variable species. In tests at the Texas Station yields of 12 strains ranged from 3,370 to 6,300 pounds of air-dry forage per acre.

Considerable information is still required to determine the range of adaptation for buffelgrass. It is recognized as having a high degree of drought tolerance, but its ability to survive winters above the upper coastal plains areas is still doubtful. Observational plantings have been made at several experiment stations in the South other than Texas, but the results on the whole have been disappointing. It is felt, however, that some of the more recent introductions are more vigorous than the earlier ones used in these tests.

### Ryegrass, *Lolium multiflorum*

Italian or annual ryegrass, a native of the Mediterranean area, was probably introduced by the early colonists and has become a major grass for winter grazing, hay, and lawns. Approximately 75,000,000 pounds of seed were produced in 1950. While succeeding without severe limitations from diseases in the upper South, it does suffer from crown rust in coastal areas.

The importance of ryegrass as a pasture grass throughout the world is reflected in the breeding program in Uruguay where a strain highly resistant to crown rust was obtained. Introductions from this source were made in 1948, 1950, and 1952. Tests of these introductions in rust areas proved them to be resistant but not immune, and segregation for resistance was immediately evident.

Because ryegrass is almost completely self-sterile it has not been possible to isolate resistant types as rapidly as possible with self-fertile plants. Work in Texas, Mississippi, Florida, and Georgia

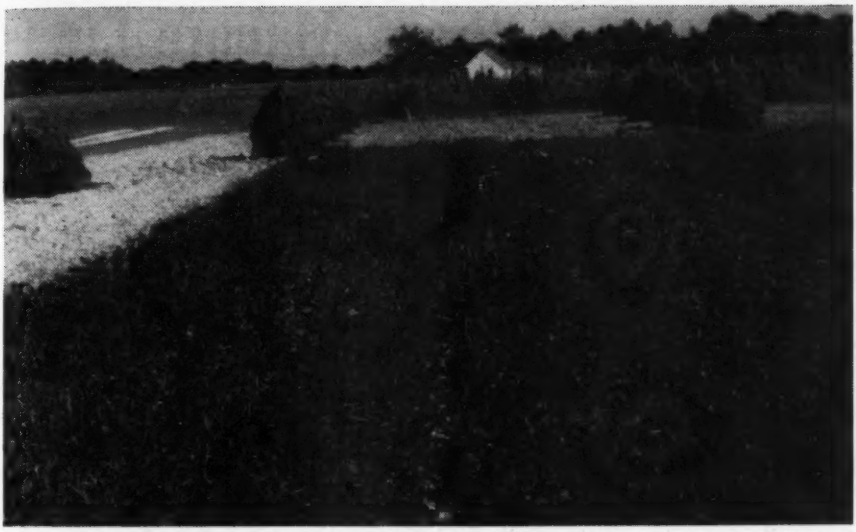

**Fig. 4. Leafspot-resistant peanut developed from an introduction, (right). Susceptible, defoliated variety, (left).**

through sib-pollination is gradually producing strains carrying a higher degree of resistance than the original introductions. Several years may yet be required before satisfactory strains are available.

### Bromegrass, *Bromus inermis* and Crested wheatgrass, *Agropyron cristatum*

These two introduced grasses have attained major importance in the United States, the former in the north-central area and the latter in the northwest. Although they are desirable, efforts to find strains of these adapted to the South have not been highly successful. An exploration through Turkey for the Plant Introduction Section by Jack Harlan of the Oklahoma Station resulted in the collection of a large number of types of both which promise to extend their southern range. Five introductions of crested wheatgrass and four of brome are apparently adapted to the conditions found in the southern Great Plains. These are being increased and tested with the possibility of developing adapted composite varieties.

### Crabgrass, *Digitaria* spp.

Crabgrasses as a group represent several commonly found throughout the South and other parts of the United States. Their contribution to forage production has been largely underestimated. Certain introductions such as the well-known Pangola grass, *Digitaria decumbens,* used extensively in southern Florida, however, are accepted as valuable forage species. Other species are also as productive as Pangola. One such species is *D. valida,* received as an introduction by the Florida Experiment Station in 1948. In 1950 at the Fruit Investigations Laboratory in Leesburg this introduction had more vigor than any other grass in the station nursery. It was found to be disease resistant and palatable to cattle. It is now being investigated as a possible silage crop or finishing pasture for cattle.

## Grain and Silage Introductions

### Sorghum, *Sorghum vulgare*

Sorghums have steadily increased in acreage in the United States since their first introduction in 1857. Through

(*Turn to page* 39)

# The Value of Green Manure Crops in Farm Practice

*By Frank App, Vernon Ichisaka, and Tejpal S. Gill*

Seabrook Farming Corporation, Bridgeton, New Jersey

COVER and green manure crops are of ranking importance in good soil management. Their potential value is not developed, and consequently, too often not used or appreciated. They furnish a superior source of organic matter, plant nutrients, and humus that enhances the bacterial life of the soil. They have an important function for improving and maintaining good soil tilth. They conserve plant-food residues left over from the cash crop and enhance the availability of plant food otherwise not available. Furthermore, cover and green manure crops are an essential part of a sound soil-conservation program.

### Selection of Cover Crop

The selection of the cover or green manure crop depends upon the purpose for which it is grown and the time of the year when the farm practice allows it to be seeded. At Seabrook Farms, we have found the combination of a legume such as crimson clover with one of the grasses such as ryegrass, wheat, barley, or rye when properly grown fulfills the requirements of soil tilth, conservation, and fertility. Of the four grasses, ryegrass is the most desirable for improving structure and tilth. After the first week of September it is too late to grow crimson clover and one of the grasses is used for the balance of September and October; for the month of November, only rye. There are other grasses still superior to ryegrass for improving soil tilth and structure. However, they are difficult to establish and not reliable enough to recommend as a general farm practice. Vetch is frequently considered one of the outstanding cover crops. We do not use it because it has the same root diseases as peas, one of our main cash crops. Our experience with vetch indicates it will give a large amount of organic matter but the root development does not appear to greatly improve the soil structure.

### Requirements for Producing Cover and Green Manure Crops

All of our crop acreage is seeded to a cover crop as soon as the cash crop is harvested. Before the seeding, soil samples are drawn from each field and analyzed to determine the residual amount of plant food left from the preceding cash crop and the amount of fertilizer essential to produce the desired quantity and quality of the particular cover crop to be grown. The seedbed of the cover crop should receive the same degree of preparation as for the cash crop. Following the seeding, fertilizer is applied in the fall or early spring. The time of application depends upon the time of seeding. The early-seeded cover crops that are well established in late September or early October are fertilized in the fall. The late-seeded cover crops that do not have enough growth to absorb most of the fertilizer application are fertilized early in the spring three to four weeks before plowing. The amount and form of fertilizer depend upon the information obtained from soil analysis and whether crimson clover is part of the cover crop. We rarely add nitrogen when

the crimson clover is seeded alone or with the grasses. We do maintain and, when necessary, add sufficient phosphorus, potash, and lime to meet the higher mineral requirements of this particular legume. It will then produce sufficient nitrogen for its own growth as well as that of the companion grass crop. Inasmuch as nitrogen is the most expensive of the various plant foods, the use of crimson clover in our operation is a good farm practice. Where the grasses are seeded alone, it is almost always essential to add nitrogen and, depending upon the fertility level of phosphorus, potash, and calcium, one or all of these elements.

### Value of Cover and Green Manure Crops

The nutritional value of properly grown cover crops in some agricultural areas is greater than their value for soil conservation. Consequently, we should re-appraise the value of cover and green manure crops in farm practice. This does not mean that they are not important in soil conservation. It does mean they should be used regardless of whether they are or are not needed for soil conservation. For many years the market gardener and truck farmer depended on organic forms of nitrogen for growing vegetables. Since stable manure is no longer available, vegetable and row crops, such as corn, are grown to a large extent by banding the fertilizer and later sidedressing. Sidedressing is essential only because nitrogen applied at the time of seeding frequently leaches away. We have found the use of well-grown cover or green manure crops, along with proper application and selection of plant food, not only eliminates the necessity of sidedressing or banding but produces greater yields at less cost. This is most marked during periods of deficient rainfall and is especially true when the deficiency occurs during the period of, or shortly before, the bud stage. The use of cover and green manure crops, supplemented with the proper essential elements, is a much better farm practice than the customary banding and side-

**Fig. 1. Cover crop comparison—Seabrook cover crop plots C-89, 1953-54.**

TABLE I.—THE INFLUENCE OF DIFFERENT AMOUNTS OF NITROGEN OR CRIMSON CLOVER ON THE TOTAL ORGANIC MATTER AND THE PERCENTAGE OF ROOTS. (FIELD C-89) 1954 AND 1955.

| Treatment | Ryegrass | | Rye | | Wheat | | Barley | |
|---|---|---|---|---|---|---|---|---|
| | Dry wt. lbs./A | % roots | Dry wt. lbs./A | % roots | Dry wt. lbs./A | % roots | Dry wt. lbs./A | % roots |
| | 1954 (April 26) | | | | | | | |
| No nitrogen | 4,450 | 24 | 5,700 | 11 | 7,000 | 11 | 5,850 | 9 |
| 60 lbs. N | 9,250 | 22 | 9,500 | 7 | 8,100 | 9 | 5,900 | 7 |
| 120 lbs. N | 7,600 | 15 | 7,050 | 8 | 12,600 | 9 | 9,050 | 7 |
| With c. clover | 7,600 | 21 | 7,600 | 14 | 6,850 | 11 | 8,350 | 5 |
| | 1955 (April 5) | | | | | | | |
| No nitrogen | 6,570 | 49 | 6,400 | 28 | 5,430 | 25 | 6,470 | 16 |
| 60 lbs. N | 8,500 | 31 | 6,880 | 22 | 6,570 | 23 | 6,500 | 19 |
| 120 lbs. N | 8,230 | 22 | 7,470 | 20 | 6,950 | 21 | 6,800 | 16 |
| With c. clover | 7,970 | 27 | 8,730 | 20 | 7,730 | 22 | 7,630 | 15 |

| | *1953–1954* | *1954–1955* |
|---|---|---|
| Cover crop planted: | Sept. 10, 1953 | Sept. 7, 1954 |
| Nitrogen applied: | March 23, 1954 | March 10, 1955 |
| Cover crop sampled: | April 26, 1954 | April 5, 1955 |

dressing of fertilizer. Furthermore, well-grown cover and green manure crops are a substitute for rotations, provided diseases and insects allow a cash crop to be grown on the same land each year.

## Organic Matter Derived from Cover Crops

The traditional rotation of American agriculture was supposed to furnish the necessary organic matter to restore and maintain tilth as well as serve as a storehouse for plant food. This farm practice has not maintained the organic matter or the necessary fertility levels. Soil scientists have usually looked forward to replenishing or increasing the organic matter in our soils to their original content. Before we had accumulated our information on cover crops through the soils laboratory and records of yields, we followed this theory for some of our crops requiring

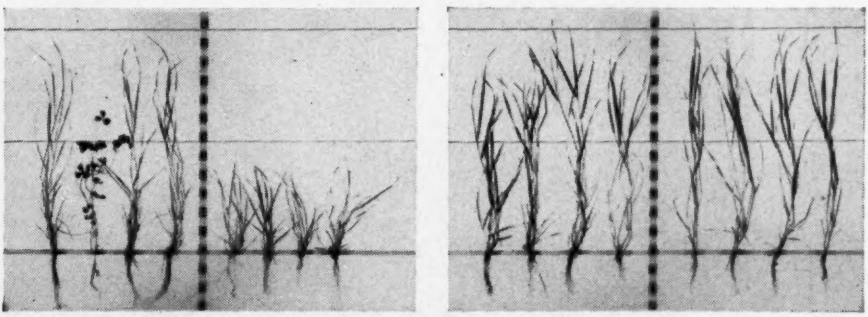

**Fig. 2. Cover crop comparison—Effect of crimson clover or nitrogen treatment on ryegrass, 1953-54. From left to right: With crimson clover; no nitrogen; 60 lbs. nitrogen; 120 lbs. nitrogen.**

TABLE II.—THE INFLUENCE OF DIFFERENT AMOUNTS OF NITROGEN OR CRIMSON CLOVER ON THE TOTAL ORGANIC MATTER AND THE PERCENTAGE OF ROOTS. (FIELD P-3A) 1955

| Treatment | Ryegrass | | Rye | | Wheat | | Barley* | | Orchardgrass | | Bromegrass* | | Average | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dry wt. lbs./A | % roots | Dry wt. lbs./A | % roots | Dry wt. lbs./A | % roots | Dry wt. lbs./A | % roots | Dry wt. lbs./A | % roots | Dry wt. lbs./A | % roots | Dry wt. lbs./A | % roots |
| No nitrogen | 8,170 | 30 | 10,800 | 16 | 10,170 | 15 | 9,320 | 15 | 5,430 | 44 | 4,040 | 26 | 7,990 | 24 |
| 60 lbs. N. | | | | | | | | | | | | | | |
| Fall | 7,600 | 25 | 17,100 | 12 | 10,550 | 15 | 12,770 | 15 | 7,550 | 37 | 5,200 | 29 | 10,130 | 22 |
| Spring | 9,300 | 28 | 13,850 | 12 | 11,270 | 15 | 12,000 | 13 | 7,920 | 32 | 7,980 | 26 | 10,390 | 21 |
| 120 lbs. N. | | | | | | | | | | | | | | |
| Fall | 10,500 | 13 | 15,720 | 13 | 12,480 | 14 | 11,470 | 13 | 8,950 | 36 | 5,980 | 26 | 10,850 | 19 |
| Spring | 8,400 | 18 | 13,030 | 13 | 12,150 | 15 | 12,750 | 11 | 9,330 | 30 | 8,970 | 25 | 10,770 | 19 |
| With c. clover | 7,190 | 31 | 14,580 | 12 | 10,910 | 18 | 9,400 | 16 | 4,450 | 30 | 4,590 | 36 | 8,520 | 24 |

*Bromegrass had poor stand.
Cover crop planted: Sept. 7, 1954
Cover crop sampled: April 24, 1955
Nitrogen application: Fall Oct. 12, 1954
Spring March 11, 1955

the highest fertility levels, such as spinach and peas.

## Objectives and Procedure of Cover and Green Manure Cropping Research

Although Seabrook Farms always followed the practice of growing cover crops, we never had any measures of their value and considered them largely from the viewpoint of soil conservation. Shortly after we organized our laboratory, we began fertilizing and analyzing our cover crops experimentally. As some preliminary research, we established definite objectives. These included: (1) Amount of organic matter derived from different cover crop species as well as from proper fertility levels established from various applications of fertilizers, (2) The quality essential for our cover crops so as to enhance the yield of the following cash crop, (3) The influence of the cover crop on the soil tilth measured in terms of soil aggregates, (4) The use of a legume as a companion crop to the grasses as a substitute for the application of nitrogen, (5) The conservation of plant-food residues left from the preceding cash crop as well as protected from wind and water erosion. In order to realize these objectives, we selected two different soil types as

TABLE III.—THE INFLUENCE OF DIFFERENT AMOUNTS OF NITROGEN OR CRIMSON CLOVER COMPANION CROP ON THE QUALITY OF THE COVER CROP. (FIELD C-89)

| Treatment | 1954 (4/26) | | | | 1955 (4/5) | | | |
|---|---|---|---|---|---|---|---|---|
| | Total dry wt. lbs./A | Per cent nitrogen | | Total nitrogen lbs./A | Total dry wt. lbs./A | Per cent nitrogen | | Total nitrogen lbs./A |
| | | Top | Root | | | Top | Root | |
| Ryegrass | | | | | | | | |
| No nitrogen | 4,450 | .58 | .31 | 23 | 6,570 | .70 | .32 | 35 |
| 60 lbs. N | 9,250 | .97 | .38 | 78 | 8,500 | 1.82 | .49 | 120 |
| 120 lbs. N | 7,600 | 1.63 | .46 | 111 | 8,230 | 3.02 | .80 | 208 |
| With c. clover | | | | | | | | |
| Ryegrass | 7,600 | .99 | .39 | 126 | 7,970 | 1.65 | .43 | 110 |
| Crimson clover | ..... | 2.42 | 1.69 | ..... | ..... | 2.88 | 1.11 | ..... |
| Rye | | | | | | | | |
| No nitrogen | 5,700 | .65 | .44 | 36 | 6,400 | .82 | .40 | 45 |
| 60 lbs. N | 9,500 | .84 | .78 | 79 | 6,880 | 2.06 | .64 | 120 |
| 120 lbs. N | 7,050 | 1.43 | .55 | 96 | 7,470 | 3.00 | .95 | 192 |
| With c. clover | | | | | | | | |
| Rye | 7,600 | .63 | .60 | 104 | 8,730 | .99 | .46 | 102 |
| Crimson clover | ..... | 2.78 | 1.62 | ..... | ..... | 2.03 | 1.75 | ..... |
| Wheat | | | | | | | | |
| No nitrogen | 7,000 | .88 | .49 | 58 | 5,430 | 1.19 | .44 | 54 |
| 60 lbs. N | 8,100 | 1.31 | .64 | 104 | 6,570 | 2.30 | .67 | 127 |
| 120 lbs. N | 12,600 | 2.10 | .84 | 251 | 6,950 | 2.48 | 1.01 | 151 |
| With c. clover | | | | | | | | |
| Wheat | 6,850 | .85 | .65 | 121 | 7,730 | 1.24 | .48 | 93 |
| Crimson clover | ..... | 2.64 | 2.29 | ..... | ..... | 2.61 | 1.48 | ..... |
| Barley | | | | | | | | |
| No nitrogen | 5,850 | .90 | .59 | 51 | 6,470 | .80 | .46 | 48 |
| 60 lbs. N | 5,900 | 1.92 | .92 | 109 | 6,500 | 2.12 | .94 | 124 |
| 120 lbs. N | 9,050 | 2.75 | 1.15 | 238 | 6,800 | 2.49 | 1.47 | 158 |
| With c. clover | | | | | | | | |
| Barley | 8,350 | 1.03 | .57 | 136 | 7,630 | .64 | .66 | 82 |
| Crimson clover | ..... | 2.93 | 1.89 | ..... | ..... | 1.99 | 1.40 | ..... |

| | *1954* | *1955* |
|---|---|---|
| Cover crop planted: | Sept. 10, 1953 | Sept. 7, 1954 |
| Nitrogen applied: | March 23, 1954 | March 10, 1955 |

follows: (1) Field C-89, sassafras sandy loam with 1.6% O. M., pH 6.1, previous crop—lima beans; (2) field P-3A, sassafras loam with 1.6% O. M., pH 6.1, previous crop—sweet corn.

These fields represent the different classes of soil from our farm operation. They had satisfactory fertility levels.

### Treatment of Plots

The three years of research reported here were confined to the use of nitrogen to grow cover crops and crimson clover as a companion crop, substituting for nitrogen. This was possible because there was a large residue of $P_2O_5$ and $K_2O$ available from the preceding cash crop. In each field on the different soils, the application of the nitrogen was made in the spring of 1954; in 1955, the plots were designed to compare fall application and spring application of nitrogen. The cover crops used were the following:

**Fig. 3. Cover crop comparison—Physical appearance of soil after plowing. Left: Wheat—2 N. Right: No cover—0 N.**

| *C-89* | *P-3A* |
|---|---|
| Ryegrass | Ryegrass |
| Rye | Rye |
| Wheat | Wheat |
| Barley | Barley |
| Orchardgrass | Orchardgrass |
| Crimson clover | Field brome |
| Ladino clover | Crimson clover |
| (2 plots Field brome) | |

Field C-89 had four treatments (no N., 60 lbs. N., 120 lbs. N., and with crimson clover) in 3 replications, using 80 plots 45′ x 14′, 7 crops used.

Field P-3A had six treatments (no N., 60 lbs. N. fall application, 60 lbs. N. spring application, 120 lbs. fall, 120 spring, and with crimson clover) in 3 replications with 162 plots 50′ x 28′, 7 crops used.

Ryegrass and orchardgrass were seeded alone at the rate of 15 lbs. Bromegrass was seeded at the rate of 20 lbs. When crimson clover was used as a companion crop, the grasses were seeded at the rate of 10 lbs. and crimson clover at 20 lbs. The grains were seeded at the rate of 100 lbs. per acre. Where crimson clover was used, 50 lbs. of the grain crop and 20 lbs. of the crimson clover were used per acre. Clovers alone were seeded at the rate of 20 lbs. per acre. The cash crops following the cover crops were peas, Fordhook limas, and sweet corn. Samples of soils were taken and analyzed periodically throughout the season to determine the influence of the cover crop on the fertility level. The yields of the cash crop were calculated in terms of peas and corn as well as the entire plant. They were analyzed for their content of N, P, and K. Observations were also made on the influence of the different types of nitrogen from different cover crops on the habit of growth of the cash crop.

From the accompanying table "Analysis of Soil Before Seeding Cover Crops in 1953 and Following Cash Crop 1954 (Field C-89)" it is quite noticeable that the potash was drawn down by the sweet corn crop. However in 1955, the pea crop which followed the sweet corn showed a very high level of $K_2O$, a higher level of $P_2O_5$, and where the cover crop received 120 lbs. of nitrogen, a high level of nitrogen.

ANALYSIS OF SOIL BEFORE SEEDING COVER CROPS IN 1953 AND FOLLOWING CASH CROP 1954 (FIELD C-89)

| Treatments* | Per cent O.M. | pH | Soil nutrients lbs./A.** | | | | |
|---|---|---|---|---|---|---|---|
| | | | CaO | MgO | N | $P_2O_5$ | $K_2O$ |
| 1953 Sept. 1 Average... | 1.6 | 6.1 | 1,255 | 160 | 16 | 22 | 277 |
| 1954 Aug. 20 Analysis After Sweet Corn Cash Crop | | | | | | | |
| No nitrogen..... | 1.5 | 6.0 | 1,241 | 148 | 26 | 17 | 171 |
| 60 lbs. N..... | 1.5 | 6.0 | 1,245 | 151 | 31 | 19 | 188 |
| 120 lbs. N..... | 1.5 | 5.9 | 1,288 | 152 | 48 | 18 | 194 |
| With c. clover..... | 1.5 | 5.9 | 1,264 | 149 | 50 | 17 | 180 |
| Average..... | 1.5 | 6.0 | 1,260 | 150 | 39 | 18 | 183 |
| 1955 June 4 Soil Analysis Prior to Pea Harvest 1955 (Field C–89) | | | | | | | |
| No nitrogen..... | 1.5 | 6.0 | 1,140 | 152 | 13 | 24 | 254 |
| 60 lbs. N..... | 1.6 | 6.0 | 1,216 | 166 | 32 | 27 | 303 |
| 120 lbs. N..... | 1.6 | 5.9 | 1,285 | 152 | 64 | 23 | 304 |
| With c. clover..... | 1.5 | 6.1 | 1,209 | 160 | 19 | 24 | 280 |
| Average..... | 1.6 | 6.0 | 1,214 | 157 | 32 | 24 | 285 |

* Average of all grass plots—ryegrass, rye, wheat, barley, and orchardgrass.
** Soil analysis based on Morgan's Universal Extracting Solution.

We selected fields having 1½% or more organic matter. For southern New Jersey, 1½% of organic matter is higher than the average. For some areas farther north, this would be very low. After we learned the value of properly grown cover crops, we found them to be the important basis for the selection of the following cash crop. Now we no longer give much consideration to the amount of organic matter in soil provided we have a well-grown cover crop to plow under. This was a major change in our farm practice. Field plots, C-89, sampled April 26, 1954, receiving 120 lbs. nitrogen March 23, produced the equivalent of 10 tons of manure in terms of organic matter. In 1955, they produced less because they had to be plowed directly after the application of the nitrogen for the following pea crop. However, they did show a substantial difference because of the preceding year's cover crop. (Table I)

There was a consistent increase in the amount of dry organic matter in the cover crop in 1955 in all the different species grown excepting ryegrass. In 1954, ryegrass and rye produced less organic matter but more quality with the higher application of nitrogen. Barley and wheat, on the other hand, produced considerably more organic matter. The quantity of organic matter and proportion of tops and roots are not a full measurement of the value of the cover crop. It is significant, however, that there is not too much difference in the total yields and proportion of roots and tops between wheat, rye, and barley. There is a considerable difference between those three and rye-

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**Fig. 1. Road effectively blocked by a "slip" from a slope covered with rank growth of cane. Scotland District, Barbados.**

# Barbadian Agriculture

*By T. S. Buie*

Soil Conservation Service, Columbia, South Carolina

BARBADOS, the most eastern island in the West Indies, scene of one of the earliest permanent European settlements in the New World, and probably the first area of land in the Western Hemisphere to be fully developed, continues after 350 years to support a dense population on a relatively high cultural and economic level. This small island which lies some 400 miles northeast of the coast of Venezuela embraces only 166 square miles of territory. Yet it supports a population of 220,000—with most of the people engaged in agricultural activities.

The first settlement was made by a party of English explorers in 1605, or about the same time as were the early English settlements on the mainland of America. The colony has continued under British dominion uninterruptedly and is quite British in viewpoint and attitude today. There is virtually no evidence of Spanish, French, Dutch, or other European influence as is the case in most of the West Indies. Barbados is unmistakably British.

The tropical climate, with a relatively well-distributed rainfall which may reach a maximum of 65 to 75 inches per year, is favorable to a wide variety of crops. These include cane, cotton, corn, bananas, plantains, and many vegetables. Coconut, bread-fruit, cocoa, and various timber trees, such as mahogany and Casuarina (Australian Pine), are adapted to the conditions found in Barbados. Most, if not

**Fig. 2. Bananas planted up-and-down-hill on steep slope, Scotland District, Barbados. Note gullies already developing from the furrows plowed between the rows.**

all, of these crops have been grown commercially from time to time and in varying quantities. But for many years cane has predominated.

### Cane—Most Important Crop

The soil is admirably suited to the culture of cane, the crop requires much land labor, and there is a ready market for the sugar throughout the British Empire. Consequently all interest is centered on sugar production and, except for a limited acreage of food crops, virtually all of the arable land is planted to cane.

Sea Island cotton once was an important crop in Barbados; otherwise the island would not have given to the plant its name—Gossypium barbadensi. Seed were sent from Barbados to establish the crop on the sea island plantations of South Carolina and Georgia. But today there is only one small field of Sea Island cotton grown on the Barbados Experiment Station farm—just enough to maintain seed stocks in the event of future need there or elsewhere.

Early in the life of the colony indentured Europeans provided labor for the larger estates, but it was not long before planters realized that black slaves from Africa were better suited to the tropical climate than were white laborers from the British Isles. And then it cost no more to buy a slave and thus secure his labor for life than to pay for the passage of an indentured servant, thereby securing his services for a period of only a few years. The number of slaves increased rapidly, therefore, and today their descendants comprise the majority of the population of the island.

As a result of the replacement of indentured servants with slaves, many of the non-land-owning group and others who were skilled artisans left Barbados to settle in Jamaica, other West Indian islands, or in the rapidly developing colonies on the mainland. This movement began within a few decades after the first settlement and may well be regarded as the forerunner of the westward movement which was destined in later years to play such an important part in the settlement of what came to be known as the United States.

From this early over-population on the small island, the colonies on the mainland, especially South Carolina,

benefited. Undoubtedly Barbadian settlers with a knowledge of New World agriculture meant much to the embryonic coastal settlement. For many years there was constant interchange of goods between Barbados and the mainland. Lumber seems to have been especially in demand in the island colony. In fact, Dr. D. D. Wallace, able South Carolina historian, says that the Charleston colonists found it easier to buy food with lumber than to raise the food.

## Too Many People Create a Problem

Overcrowding, which so early had its effect on the economic life and culture of this early British colony, continues to plague it until the present—and there is no relief in sight. With almost 1,400 people per square mile, Barbados is said to be one of the most densely populated areas in the world. It is amazing how these people have been able to maintain themselves as well as they have for there is little evidence of hunger or even of an unbalanced diet. All appear to be healthy, robust, and happy.

To appreciate the overcrowded situation which exists at present, one has only to realize that with an average of nearly 1,400 people to the square mile there is available for each one a plot of land only approximately 142 feet square. And if the present numerical rate of increase of 4,000 per year continues, within 10 years the size of this

**Fig. 3. A 14-year-old Casuarina (Australian Pine) tree growing on what was a bare, badly eroded slope. Scotland District, Barbados.**

**Fig. 4. Grass will take over even on steep, badly eroded areas if given a chance. Only difference is that animals have been excluded from foreground.**

hypothetical block of land will have shrunk to only about 138 feet on each side. And within 50 years there will be less than one-fourth acre of land for each person. Such a small area to serve for all purposes—farm land, roads, building sites, public areas, and recreation!

### All Land Is Used Intensively

Virtually every scrap of land is used for production of crops. The more level to gently rolling areas are planted to cane, and the steeper and severely eroded slopes—including the road-banks—are given over to sour grass which is cut and used for mulching the newly planted cane.

Forested areas are almost unknown. Only one area of a few acres of original forest remains, and only scattered plantings of trees, usually Casuarina (Australian Pine), have been made on the areas of shallow soil or where erosion is severe. Despite the fact that wood is extremely scarce—firewood for cooking is said to sell for one cent per pound—the density of population simply will not permit land which will produce any kind of a crop of cane or food to be planted to trees. And the sheep and goats owned by the peasants present a serious problem. No fences are to be seen on the island. All animals are grazed by hand or "staked out." Many of the peasants who own but small plots of land, or none at all, keep sheep and goats and depend upon the sparse grazing available in the vicinity of their homes for the sustenance of the animals.

Cane is planted in the late fall months and the first yield secured some 15 months later. This first crop is known as "plant cane" and is followed by some 3 to 5 ratoon crops, which grow without further attention except fertilizer. When the yield of the ratoon crop declines to the point where replanting is profitable, the land is plowed after the harvest, and corn, beans, peas, yams, and sweet potatoes are planted. Unfortunately, these crops do not demand as much respect as does cane. The same old story—prime dependence upon the cash crop, and only minor consideration given to the others!

### Heavy Applications of Fertilizer Necessary

It is only by using intense methods of cultivation, including relatively high applications of commercial fertilizer, that the farmers of Barbados have been able to maintain their yields sufficiently high to support the people who live there. The typical fertilizer application to cane is said to be as follows: 224 pounds of 53% muriate of potash per acre applied in January, followed by 450 pounds of sulphate of ammonia to first-year cane, and 280 pounds to ratoon cane in July. In addition, stable manure is used on the thin spots in the field.

All organic matter is carefully conserved to be returned to the land. The wasteful practice of flash burning just ahead of cane harvest, so as to make it easier for the laborers to cut, seems not to have gained any favor in Barbados. Residue from the previous crop or hay cut from roadsides or abandoned hillsides is used to mulch all newly planted cane.

The land ownership pattern presents a particularly difficult problem. There are only some 300 to 400 estates of more than 10 acres each, whereas the number of holdings in 1946 classified as farms was 8,586. Individual holdings of rural land approximate 30,000, of which approximately 85% are no more than one acre in size. Obviously, the occupants of such small areas cannot subsist on the products of the land they own or control. Most of them are employed on the larger sugar plantations and this within itself handicaps their efficient use of the land on which they live, for at the very time when they should be engaged in working for themselves, their services are demanded by their employers. The result is further

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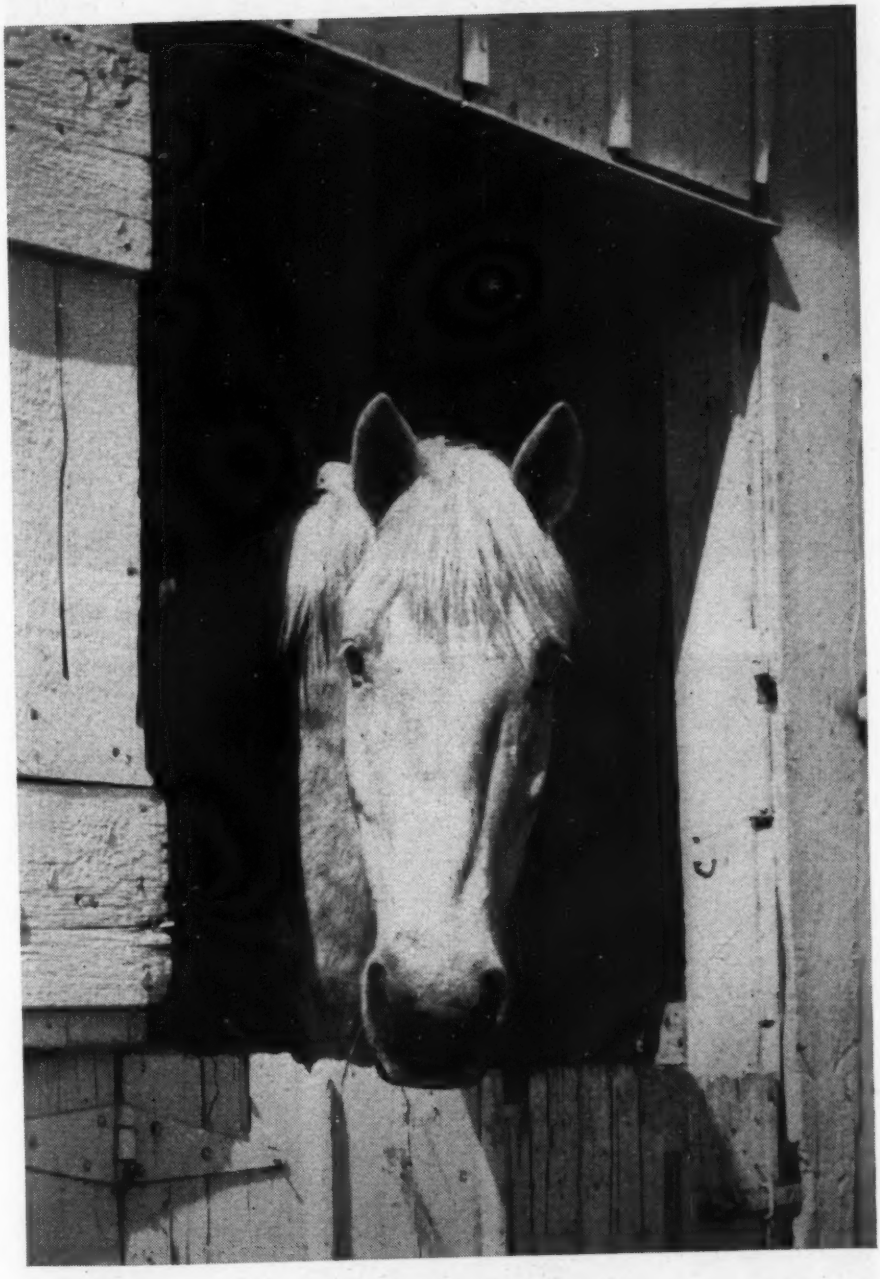
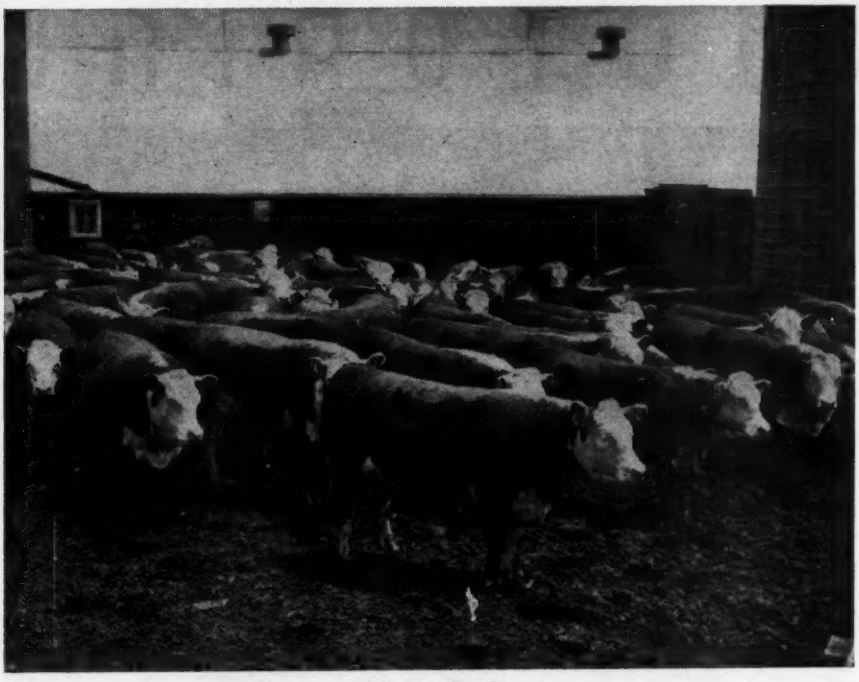
# PICTORIAL

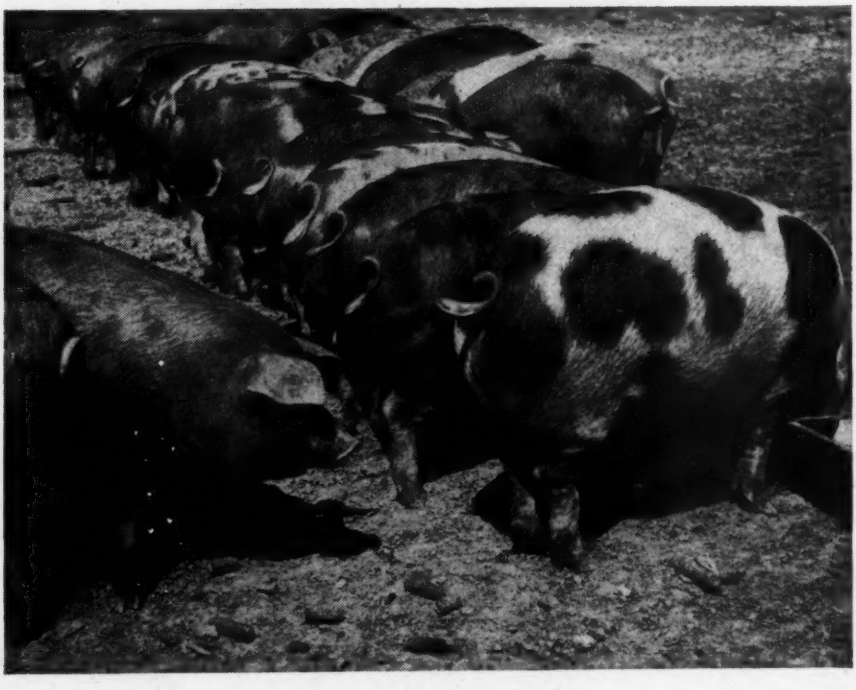


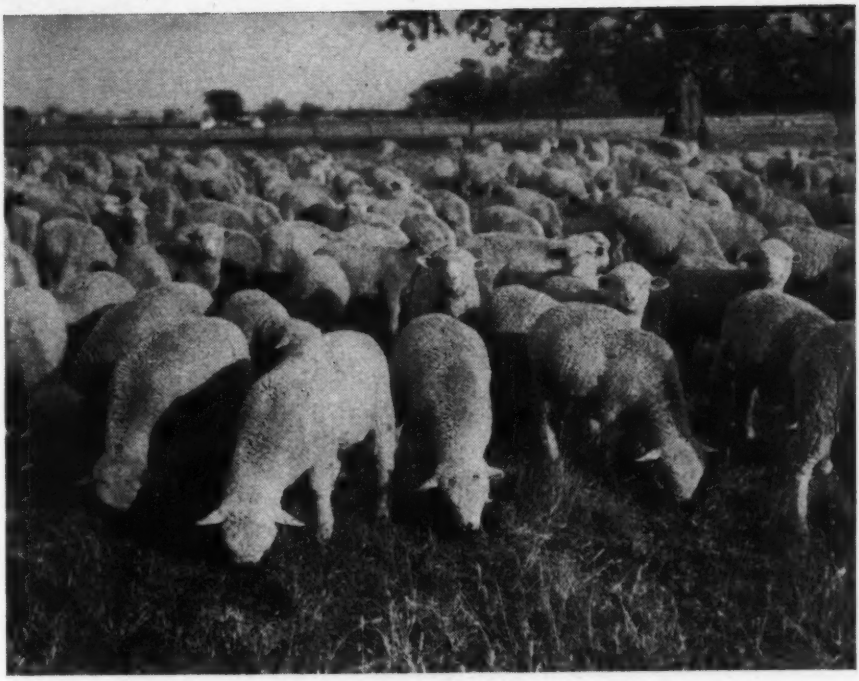
**No Longer Needed!**



**Above: Beef**

**Below: Pork**





**Above: Lamb**

**Below: Fowl**

**Above: Burning a strawstack wastes organic matter.**

**Below: Fertilizers and cornstalks build humus.**

# The Editors Talk

## Our Cover Picture

Cotton rust has been associated with potash starvation so long that it is probable most cotton growers readily recognize the reddish-brown dried leaves and premature shedding as due to lack of this essential plant food. However, long before such severe symptoms appear, potash starvation can be diagnosed by a yellowish-white mottling of the leaf. The leaf changes to a light yellowish-green, and yellow spots appear between the veins. The centers of these spots die, and numerous brown specks form at the tip of the leaf, around the margin, and between the veins.

To aid in identifying these early symptoms, we are pleased to show on our cover this month the first two stages of evidence of potash starvation—top, the first symptom, the yellowish-white mottling, and below, the second stage, the changing to a light yellowish-green. Not shown is what follows—the breakdown of the tip and margin of the leaf with the downward curling. The whole leaf finally becomes reddish-brown in color, dries, and is shed prematurely, resulting in dwarfed and immature bolls.

As with other nutrient deficiencies, severe damage to crop production may occur before even early symptoms of the starvation appear. Soil testing is one of the best means of determining supply and availability of plant food for the crop to be grown and insuring against the losses caused by inadequate fertilization.

## Chemistry and Agriculture

In an address before the National Agricultural Chemicals Association in St. Louis last year, True D. Morse, Under Secretary of Agriculture, presented some facts which bear out Agriculture's ever-increasing dependence on chemistry and the chemical industry. Speaking of fertilizers, he stated that industry and agriculture working together doubled the use of fertilizer in 10 years. This expansion will continue as more effective use of plant foods is made in the future. He predicted that increasing numbers of farmers will come to realize that high yields per acre usually mean increased profits and that fertilizers effectively used are a quick and sure way to higher crop yields.

Although fertilizer may be the chief product of the chemical industry used by the farmer, it by no means is the only important one. Pointing out that farming continues to be a contest between man and his natural enemies, Mr. Morse said it is a costly contest that runs into billions of dollars each year. Hundreds of aggressive weeds competing with crops reduce crop values annually more than $2 billion. There are about 350 plant diseases of major economic importance taking a toll of almost $3 billion. There are several thousand fungi and many different kinds of bacteria and viruses that attack plants and animals. Some 700 different insect pests annually destroy $2 billion worth of crops.

Annual production losses in farm crops from all causes amount to about $8.3 billion—20% of the annual farm production potential. Over $2.5 billion worth of farm animals and animal products are lost to diseases, parasites, and insects. Annual losses to crops, pastures, ranges, livestock, and products total more than $13 billion—a big order for the chemical industry.

Mr. Morse stated that constructive selling by the chemical industry has been a powerful educational and extension force and a major reason why agricultural chemicals are being used increasingly. "There should be continuing emphasis on factual information—and how to use—and how not to use—to get best results. There is too little information on the 'dollar and cents' value for the farmers who want to step up their profits."

He was of the opinion that many farmers are confused by a whole list of chemicals and formulas, and are uncertain about which to use and what results to expect. It is one reason why they turn to custom operators. Companies may find it advisable to intensify their work with farmers who buy good equipment and who do custom work for their neighbors. The trend toward specialization will continue, and it is reasonable to expect more custom workers and specialists working with farmers in the use of agricultural chemicals.

In citing the need for more research to combat new problems, Mr. Morse paid further tribute to industry: "Industry is spending as much on agricultural research as the combined efforts of public agencies. Industry expenditures are estimated at well over $140 million a year. Public expenditures for such research, both state and federal, total near $143 million. We salute industry for big investments in research which help make farmers and agriculture generally the most efficient and prosperous in the world.

"The results of agricultural research dwarf the benefits of most other types of farm programs. Research and education make farm bank accounts grow with better production and farming methods—and more effective selling and marketing. In all these developments the Land-Grant Colleges, Experiment Stations, and Extension Services have played a major role.

"The U. S. Department of Agriculture and the Colleges take pride in the good cooperative relationships with the chemical and other industries. It is teamwork that pays. Scientists are eager to exchange information. We must continue to work together to get rapid progress and gain the full economic benefits of new developments."

**What Is Profit?** "From my layman's viewpoint, profit would seem to consist of two components, i. e., the net return per unit of operation or product and the number of units of operation or product. The net return per unit is, in turn, the difference between gross income per unit and cost per unit. This net return per unit can, therefore, be increased by a higher price for the finished product, by more efficient production methods which reduce the cost per unit, or by a combination of both of these forces. The total profit, in turn, can be increased by raising the net profit per unit, by increasing the number of units, or by a combination of both. Profit on the farm can, therefore, be influenced by three factors, i. e., prices of farm products, cost of production, and total production. Generally speaking, individual farmers are powerless with respect to the first of these factors and even when acting collectively they have the power only in very special cases to influence price of product. Farmers do have, however, within their grasp power to influence the latter two factors, i. e., cost of production and total production." . . . *W. M. Myers, University of Minnesota.*

## Season Average Prices Received by Farmers for Specified Commodities *

| Crop Year | Cotton Cents per lb. Aug.-July | Tobacco Cents per lb. ..... | Potatoes Cents per bu. July-June | Sweet Potatoes Cents per bu. July-June | Corn Cents per bu. Oct.-Sept. | Wheat Cents per bu. July-June | Hay [1] Dollars per ton July-June | Cottonseed Dollars per ton July-June | Truck Crops .... |
|---|---|---|---|---|---|---|---|---|---|
| Av. Aug. 1909–July 1914.... | 12.4 | 10.0 | 69.7 | 87.8 | 64.2 | 88.4 | 11.87 | 22.55 | .... |
| 1930..... | 9.5 | 12.8 | 91.2 | 108.1 | 59.8 | 67.1 | 11.06 | 22.04 | .... |
| 1931..... | 5.7 | 8.2 | 46.0 | 72.6 | 32.0 | 39.0 | 8.69 | 8.97 | .... |
| 1932..... | 6.5 | 10.5 | 38.0 | 54.2 | 31.9 | 28.2 | 6.20 | 10.33 | .... |
| 1933..... | 10.2 | 13.0 | 82.4 | 69.4 | 52.2 | 74.4 | 8.09 | 12.88 | .... |
| 1934..... | 12.4 | 21.3 | 44.6 | 79.8 | 81.5 | 84.8 | 13.20 | 33.00 | .... |
| 1935..... | 11.1 | 18.4 | 59.3 | 70.3 | 65.5 | 83.2 | 7.52 | 30.54 | .... |
| 1936..... | 12.4 | 23.6 | 114.2 | 92.9 | 104.4 | 102.5 | 11.20 | 33.36 | .... |
| 1937..... | 8.4 | 20.4 | 52.9 | 78.0 | 51.8 | 96.2 | 8.74 | 19.51 | .... |
| 1938..... | 8.6 | 19.6 | 55.7 | 69.8 | 48.6 | 56.2 | 6.78 | 21.79 | .... |
| 1939..... | 9.1 | 15.4 | 69.7 | 73.4 | 56.8 | 69.1 | 7.94 | 21.17 | .... |
| 1940..... | 9.9 | 16.0 | 54.1 | 85.4 | 61.8 | 68.2 | 7.59 | 21.73 | .... |
| 1941..... | 17.0 | 26.4 | 80.8 | 92.2 | 75.1 | 94.4 | 9.70 | 47.65 | .... |
| 1942..... | 19.0 | 36.9 | 117.0 | 118.0 | 91.7 | 110.0 | 10.80 | 45.61 | .... |
| 1943..... | 19.9 | 40.5 | 131.0 | 206.0 | 112.0 | 136.0 | 14.80 | 52.10 | .... |
| 1944..... | 20.7 | 42.0 | 150.0 | 190.0 | 109.0 | 141.0 | 16.50 | 52.70 | .... |
| 1945..... | 22.5 | 36.6 | 143.0 | 204.0 | 127.0 | 150.0 | 15.10 | 51.10 | .... |
| 1946..... | 32.6 | 38.2 | 124.0 | 218.0 | 156.0 | 191.0 | 16.70 | 72.00 | .... |
| 1947..... | 31.9 | 38.0 | 162.0 | 217.0 | 216.0 | 229.0 | 17.60 | 85.90 | .... |
| 1948..... | 30.4 | 48.2 | 155.0 | 222.0 | 129.0 | 200.0 | 18.45 | 67.20 | .... |
| 1949..... | 28.6 | 45.9 | 128.0 | 214.0 | 124.0 | 188.0 | 16.50 | 43.40 | .... |
| 1950..... | 40.1 | 51.7 | 91.7 | 173.0 | 153.0 | 200.0 | 16.70 | 86.50 | .... |
| 1951..... | 37.9 | 51.1 | 163.0 | 304.0 | 166.0 | 211.0 | 19.50 | 69.30 | .... |
| 1952..... | 34.6 | 49.9 | 198.0 | 338.0 | 153.0 | 209.0 | 19.95 | 69.60 | .... |
| 1953..... | 32.3 | 52.2 | 78.1 | 244.0 | 148.0 | 204.0 | 17.45 | 52.60 | .... |
| 1954..... | 33.6 | 51.4 | 123.0 | 216.0 | 143.0 | 214.0 | 17.35 | 60.30 | .... |
| 1955 | | | | | | | | | |
| March..... | 31.87 | .... | 118.0 | 310.0 | 136.0 | 212.0 | 18.25 | 53.40 | .... |
| April..... | 31.93 | .... | 217.0 | 315.0 | 136.0 | 209.0 | 17.65 | 53.40 | .... |
| May..... | 31.51 | 46.0 | 223.0 | 315.0 | 140.0 | 213.0 | 17.45 | 53.10 | .... |
| June..... | 31.43 | 39.5 | 121.0 | 392.0 | 140.0 | 206.0 | 16.35 | 52.00 | .... |
| July..... | 32.11 | 38.0 | 88.0 | 279.0 | 140.0 | 197.0 | 15.25 | 54.00 | .... |
| August..... | 32.74 | 50.6 | 75.2 | 179.0 | 130.0 | 190.0 | 15.25 | 50.10 | .... |
| September... | 33.77 | 51.5 | 71.3 | 142.0 | 124.0 | 192.0 | 15.55 | 43.70 | .... |
| October..... | 32.83 | 55.0 | 72.3 | 144.0 | 114.0 | 194.0 | 15.75 | 43.50 | .... |
| November... | 32.42 | 52.5 | 82.9 | 168.0 | 109.0 | 194.0 | 16.05 | 44.30 | .... |
| December.... | 31.19 | 57.2 | 80.7 | 203.0 | 115.0 | 195.0 | 16.55 | 45.00 | .... |
| 1956 | | | | | | | | | |
| January..... | 30.67 | 51.3 | 99.4 | 199.0 | 116.0 | 195.0 | 16.55 | 45.50 | .... |
| February.... | 31.00 | 35.4 | 114.0 | 198.0 | 118.0 | 195.0 | 16.45 | 46.20 | .... |
| **Index Numbers (Aug. 1909–July 1914 = 100)** | | | | | | | | | |
| 1930..... | 77 | 128 | 131 | 123 | 93 | 76 | 93 | 98 | 128 |
| 1931..... | 46 | 82 | 66 | 83 | 50 | 44 | 73 | 40 | 107 |
| 1932..... | 52 | 105 | 55 | 62 | 50 | 43 | 52 | 46 | 100 |
| 1933..... | 82 | 130 | 118 | 79 | 81 | 84 | 68 | 57 | 90 |
| 1934..... | 100 | 213 | 64 | 91 | 127 | 96 | 111 | 146 | 94 |
| 1935..... | 90 | 184 | 85 | 80 | 102 | 94 | 63 | 135 | 116 |
| 1936..... | 100 | 236 | 164 | 106 | 163 | 116 | 94 | 148 | 108 |
| 1937..... | 68 | 204 | 76 | 89 | 81 | 109 | 74 | 87 | 114 |
| 1938..... | 69 | 196 | 80 | 79 | 76 | 64 | 57 | 97 | 96 |
| 1939..... | 73 | 154 | 100 | 84 | 88 | 78 | 67 | 94 | 98 |
| 1940..... | 80 | 160 | 78 | 97 | 96 | 77 | 64 | 96 | 122 |
| 1941..... | 137 | 264 | 116 | 105 | 117 | 107 | 82 | 211 | 138 |
| 1942..... | 153 | 369 | 168 | 134 | 143 | 124 | 91 | 202 | 178 |
| 1943..... | 160 | 405 | 188 | 235 | 174 | 154 | 125 | 231 | 270 |
| 1944..... | 167 | 420 | 214 | 216 | 170 | 160 | 139 | 234 | 236 |
| 1945..... | 181 | 366 | 205 | 232 | 198 | 170 | 127 | 227 | 240 |
| 1946..... | 263 | 382 | 178 | 248 | 212 | 209 | 141 | 319 | 217 |
| 1947..... | 257 | 380 | 232 | 248 | 336 | 259 | 148 | 381 | 262 |
| 1948..... | 245 | 482 | 222 | 253 | 201 | 226 | 155 | 298 | 253 |
| 1949..... | 231 | 459 | 184 | 244 | 193 | 213 | 139 | 192 | 232 |
| 1950..... | 323 | 517 | 132 | 197 | 238 | 226 | 141 | 384 | 211 |
| 1951..... | 306 | 512 | 233 | 346 | 259 | 239 | 164 | 307 | 269 |
| 1952..... | 279 | 499 | 284 | 385 | 238 | 236 | 168 | 309 | 274 |
| 1953..... | 260 | 522 | 112 | 278 | 231 | 231 | 147 | 233 | 240 |
| 1954..... | 270 | 514 | 176 | 246 | 223 | 242 | 146 | 267 | 228 |
| 1955 | | | | | | | | | |
| March..... | 257 | ... | 169 | 353 | 212 | 240 | 154 | 237 | 262 |
| April..... | 258 | ... | 311 | 359 | 212 | 236 | 149 | 237 | 270 |
| May..... | 154 | 460 | 320 | 359 | 218 | 241 | 147 | 235 | 308 |
| June..... | 253 | 395 | 174 | 435 | 218 | 233 | 138 | 231 | 230 |
| July..... | 259 | 380 | 126 | 318 | 218 | 223 | 128 | 239 | 223 |
| August..... | 264 | 506 | 108 | 204 | 202 | 215 | 128 | 222 | 211 |
| September... | 272 | 515 | 102 | 162 | 193 | 217 | 131 | 194 | 230 |
| October..... | 265 | 550 | 104 | 164 | 178 | 219 | 133 | 193 | 223 |
| November... | 261 | 525 | 119 | 191 | 170 | 219 | 135 | 196 | 231 |
| December.... | 252 | 572 | 118 | 231 | 179 | 221 | 139 | 200 | 231 |
| 1956 | | | | | | | | | |
| January..... | 247 | 513 | 143 | 227 | 181 | 221 | 139 | 202 | 244 |
| February.... | 250 | 354 | 164 | 226 | 184 | 221 | 139 | 205 | 244 |

## Wholesale Prices of Phosphates and Potash * *

| | Superphosphate, Baltimore, per unit | Florida land, pebble, 68% f.o.b. mines, bulk, per ton | Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton | Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports [2] | Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports [2] | Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports [2] | Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports [2] |
|---|---|---|---|---|---|---|---|
| 1910–14 | $0.536 | $3.61 | $4.88 | $0.714 | $0.953 | $24.18 | $0.657 |
| 1930 | .542 | 3.18 | 5.50 | .681 | .973 | 26.92 | .618 |
| 1931 | .485 | 3.18 | 5.50 | .681 | .973 | 26.92 | .618 |
| 1932 | .458 | 3.18 | 5.50 | .681 | .963 | 26.90 | .618 |
| 1933 | .434 | 3.11 | 5.50 | .662 | .864 | 25.10 | .601 |
| 1934 | .487 | 3.14 | 5.67 | .486 | .751 | 22.49 | .483 |
| 1935 | .492 | 3.30 | 5.69 | .415 | .684 | 21.44 | .444 |
| 1936 | .476 | 1.85 | 5.50 | .464 | .708 | 22.94 | .505 |
| 1937 | .510 | 1.85 | 5.50 | .508 | .757 | 24.70 | .556 |
| 1938 | .492 | 1.85 | 5.50 | .523 | .774 | 15.17 | .572 |
| 1939 | .478 | 1.90 | 5.50 | .521 | .751 | 24.52 | .570 |
| 1940 | .516 | 1.90 | 5.50 | .517 | .730 | 24.75 | .573 |
| 1941 | .547 | 1.94 | 5.64 | .522 | .780 | 25.55 | .367 |
| 1942 | .600 | 2.13 | 6.29 | .522 | .810 | 25.74 | .205 |
| 1943 | .631 | 2.00 | 5.93 | .522 | .786 | 25.35 | .195 |
| 1944 | .645 | 2.10 | 6.10 | .522 | .777 | 25.35 | .195 |
| 1945 | .650 | 2.20 | 6.23 | .522 | .777 | 25.35 | .195 |
| 1946 | .671 | 2.41 | 6.50 | .508 | .769 | 24.70 | .190 |
| 1947 | .746 | 3.05 | 6.60 | .432 | .706 | 18.93 | .195 |
| 1948 | .764 | 4.27 | 6.60 | .397 | .681 | 14.14 | .195 |
| 1949 | .770 | 3.88 | 6.22 | .397 | .703 | 14.14 | .195 |
| 1950 | .763 | 3.83 | 5.47 | .371 | .716 | 14.33 | .195 |
| 1951 | .813 | 3.98 | 5.47 | .401 | .780 | 15.25 | .200 |
| 1952 | .849 | 3.98 | 5.47 | .401 | .793 | 15.25 | .200 |
| 1953 | .878 | .... | .... | .410 | .793 | 15.25 | .200 |
| 1954 | .895 | .... | .... | .405 | .791 | 15.27 | .200 |
| 1955 | | | | | | | |
| March | .895 | .... | .... | .405 | .825 | 16.00 | .193 |
| April | .895 | .... | .... | .405 | .825 | 16.00 | .193 |
| May | .895 | .... | .... | .405 | .825 | 16.00 | .193 |
| June | .895 | .... | .... | .360 | .720 | 13.45 | .175 |
| July | .895 | .... | .... | .390 | .735 | 14.00 | .193 |
| August | .895 | .... | .... | .390 | .735 | 14.00 | .193 |
| September | .895 | .... | .... | .390 | .735 | 14.00 | .193 |
| October | .895 | .... | .... | .390 | .735 | 14.00 | .193 |
| November | .895 | .... | .... | .390 | .735 | 14.00 | .193 |
| December | .895 | .... | .... | .390 | .735 | 14.00 | .193 |
| 1956 | | | | | | | |
| January | .895 | .... | .... | .390 | .735 | 14.00 | .193 |
| February | .895 | .... | .... | .390 | .735 | 14.00 | .193 |
| | **Index Numbers (1910-14 = 100)** | | | | | | |
| 1930 | 101 | 88 | 113 | 95 | 102 | 111 | 94 |
| 1931 | 90 | 88 | 113 | 95 | 102 | 111 | 94 |
| 1932 | 85 | 88 | 113 | 95 | 101 | 111 | 94 |
| 1933 | 81 | 86 | 113 | 93 | 91 | 104 | 91 |
| 1934 | 91 | 87 | 110 | 68 | 79 | 93 | 74 |
| 1935 | 92 | 91 | 117 | 58 | 72 | 89 | 68 |
| 1936 | 89 | 51 | 113 | 65 | 74 | 95 | 77 |
| 1937 | 95 | 51 | 113 | 71 | 79 | 102 | 85 |
| 1938 | 92 | 51 | 113 | 73 | 81 | 104 | 87 |
| 1939 | 89 | 53 | 113 | 73 | 79 | 101 | 87 |
| 1940 | 96 | 53 | 113 | 72 | 77 | 102 | 87 |
| 1941 | 102 | 54 | 110 | 73 | 82 | 106 | 87 |
| 1942 | 112 | 59 | 129 | 73 | 85 | 106 | 84 |
| 1943 | 117 | 55 | 121 | 73 | 82 | 105 | 83 |
| 1944 | 120 | 58 | 125 | 73 | 82 | 105 | 83 |
| 1945 | 121 | 61 | 128 | 73 | 82 | 105 | 83 |
| 1946 | 125 | 67 | 133 | 71 | 81 | 102 | 82 |
| 1947 | 139 | 84 | 135 | 70 | 74 | 78 | 83 |
| 1948 | 143 | 118 | 135 | 67 | 72 | 58 | 83 |
| 1949 | 144 | 108 | 128 | 67 | 74 | 58 | 83 |
| 1950 | 142 | 106 | 112 | 68 | 75 | 59 | 83 |
| 1951 | 152 | 110 | 112 | 72 | 82 | 63 | 83 |
| 1952 | 158 | 110 | 112 | 72 | 83 | 63 | 83 |
| 1953 | 164 | ... | ... | 73 | 83 | 63 | 83 |
| 1954 | 167 | ... | ... | 72 | 83 | 63 | 83 |
| 1955 | | | | | | | |
| March | 167 | ... | ... | 72 | 87 | 66 | 83 |
| April | 167 | ... | ... | 72 | 87 | 66 | 83 |
| May | 167 | ... | ... | 72 | 87 | 66 | 83 |
| June | 167 | ... | ... | 66 | 76 | 56 | 80 |
| July | 167 | ... | ... | 70 | 77 | 58 | 82 |
| August | 167 | ... | ... | 70 | 77 | 58 | 82 |
| September | 167 | ... | ... | 70 | 77 | 58 | 82 |
| October | 167 | ... | ... | 70 | 77 | 58 | 82 |
| November | 167 | ... | ... | 70 | 77 | 58 | 82 |
| December | 167 | ... | ... | 70 | 77 | 58 | 82 |
| 1956 | | | | | | | |
| January | 167 | ... | ... | 70 | 77 | 58 | 82 |
| February | 167 | ... | ... | 70 | 77 | 58 | 82 |

## Wholesale Prices of Ammoniates * *

| | Nitrate of soda bulk per unit N | Sulphate of ammonia bulk per unit N | Cottonseed meal S. E. Mills per unit N | Fish, scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory bulk per unit N | Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N | High grade ground blood, 16–17 % ammonia, Chicago, bulk, per unit N |
|---|---|---|---|---|---|---|
| 1910–14 | $2.68 | $2.85 | $3.50 | $3.53 | $3.37 | $3.52 |
| 1930 | 2.47 | 1.81 | 4.78 | 4.96 | 3.79 | 4.58 |
| 1931 | 2.34 | 1.46 | 3.10 | 3.95 | 2.11 | 2.46 |
| 1932 | 1.87 | 1.04 | 2.18 | 2.18 | 1.21 | 1.36 |
| 1933 | 1.52 | 1.12 | 2.95 | 2.86 | 2.06 | 2.46 |
| 1934 | 1.52 | 1.20 | 4.46 | 3.15 | 2.67 | 3.27 |
| 1935 | 1.47 | 1.15 | 4.59 | 3.10 | 3.06 | 3.65 |
| 1936 | 1.53 | 1.23 | 4.17 | 3.42 | 3.58 | 4.25 |
| 1937 | 1.63 | 1.32 | 4.91 | 4.66 | 4.04 | 4.80 |
| 1938 | 1.69 | 1.38 | 3.69 | 3.76 | 3.15 | 3.53 |
| 1939 | 1.69 | 1.35 | 4.02 | 4.41 | 3.87 | 3.90 |
| 1940 | 1.69 | 1.36 | 4.64 | 4.36 | 3.33 | 3.39 |
| 1941 | 1.69 | 1.41 | 5.50 | 5.32 | 3.76 | 4.43 |
| 1942 | 1.74 | 1.41 | 6.11 | 5.77 | 5.04 | 6.76 |
| 1943 | 1.75 | 1.42 | 6.30 | 5.77 | 4.86 | 6.62 |
| 1944 | 1.75 | 1.42 | 7.68 | 5.77 | 4.86 | 6.71 |
| 1945 | 1.75 | 1.42 | 7.81 | 5.77 | 4.86 | 6.71 |
| 1946 | 1.97 | 1.44 | 11.04 | 7.38 | 6.60 | 9.33 |
| 1947 | 2.50 | 1.60 | 12.72 | 10.66 | 12.63 | 10.46 |
| 1948 | 2.86 | 2.03 | 12.94 | 10.59 | 10.84 | 9.85 |
| 1949 | 3.15 | 2.29 | 10.11 | 13.18 | 10.73 | 10.62 |
| 1950 | 3.00 | 1.95 | 11.01 | 11.70 | 10.21 | 9.36 |
| 1951 | 3.16 | 1.97 | 13.20 | 10.92 | 10.18 | 10.09 |
| 1952 | 3.34 | 2.09 | 13.95 | 11.27 | 9.72 | 9.16 |
| 1953 | 3.26 | 2.27 | 11.04 | 11.19 | 7.39 | 7.09 |
| 1954 | 3.07 | 2.20 | 11.50 | 11.63 | 9.72 | 9.85 |
| 1955 | | | | | | |
| March | 2.98 | 2.18 | 10.47 | 12.45 | 7.82 | 7.82 |
| April | 2.98 | 2.18 | 9.90 | 12.41 | 6.68 | 6.23 |
| May | 2.98 | 2.16 | 9.97 | 11.92 | 6.19 | 6.25 |
| June | 2.98 | 2.02 | 9.91 | 11.55 | 6.23 | 5.92 |
| July | 2.98 | 2.02 | 10.01 | 9.43 | 6.68 | 7.14 |
| August | 2.98 | 2.07 | 9.88 | 11.12 | 7.04 | 6.86 |
| September | 2.98 | 2.05 | 9.29 | 11.60 | 6.75 | 6.53 |
| October | 2.98 | 2.07 | 9.17 | 13.01 | 7.47 | 7.16 |
| November | 2.98 | 2.07 | 8.71 | 13.10 | 6.14 | 6.23 |
| December | 2.98 | 2.12 | 9.21 | 12.93 | 5.66 | 6.00 |
| 1956 | | | | | | |
| January | 2.98 | 2.12 | 9.43 | 12.75 | 5.58 | 5.58 |
| February | 2.98 | 2.12 | 8.67 | 12.15 | 5.77 | 5.69 |
| | **Index Numbers (1910-14 = 100)** | | | | | |
| 1930 | 92 | 64 | 137 | 141 | 112 | 130 |
| 1931 | 88 | 51 | 89 | 112 | 63 | 70 |
| 1932 | 71 | 36 | 62 | 62 | 36 | 39 |
| 1933 | 59 | 39 | 84 | 81 | 97 | 71 |
| 1934 | 59 | 42 | 127 | 89 | 79 | 93 |
| 1935 | 57 | 40 | 131 | 88 | 91 | 104 |
| 1936 | 59 | 43 | 119 | 97 | 106 | 131 |
| 1937 | 61 | 46 | 140 | 132 | 120 | 122 |
| 1938 | 63 | 48 | 105 | 106 | 93 | 100 |
| 1939 | 63 | 47 | 115 | 125 | 115 | 111 |
| 1940 | 63 | 48 | 133 | 124 | 99 | 96 |
| 1941 | 63 | 49 | 157 | 151 | 112 | 126 |
| 1942 | 65 | 49 | 175 | 163 | 150 | 192 |
| 1943 | 65 | 50 | 180 | 163 | 144 | 189 |
| 1944 | 65 | 50 | 219 | 163 | 144 | 191 |
| 1945 | 65 | 50 | 223 | 163 | 144 | 191 |
| 1946 | 74 | 51 | 315 | 209 | 196 | 265 |
| 1947 | 93 | 56 | 363 | 302 | 374 | 297 |
| 1948 | 107 | 71 | 370 | 300 | 322 | 280 |
| 1949 | 117 | 80 | 289 | 373 | 318 | 302 |
| 1950 | 112 | 68 | 315 | 331 | 303 | 266 |
| 1951 | 118 | 69 | 377 | 310 | 302 | 287 |
| 1952 | 125 | 74 | 399 | 319 | 288 | 260 |
| 1953 | 122 | 80 | 315 | 317 | 219 | 201 |
| 1954 | 114 | 77 | 329 | 330 | 288 | 280 |
| 1955 | | | | | | |
| March | 111 | 76 | 299 | 353 | 232 | 222 |
| April | 111 | 76 | 283 | 352 | 198 | 177 |
| May | 111 | 76 | 285 | 338 | 184 | 178 |
| June | 111 | 71 | 283 | 327 | 185 | 168 |
| July | 111 | 71 | 286 | 267 | 198 | 203 |
| August | 111 | 73 | 282 | 315 | 209 | 195 |
| September | 111 | 72 | 265 | 329 | 200 | 186 |
| October | 111 | 73 | 262 | 369 | 222 | 203 |
| November | 111 | 73 | 249 | 371 | 182 | 177 |
| December | 111 | 74 | 263 | 366 | 168 | 170 |
| 1956 | | | | | | |
| January | 111 | 74 | 269 | 361 | 166 | 159 |
| February | 111 | 74 | 248 | 344 | 171 | 162 |

## Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

| | Farm prices* | Prices paid by farmers for commodities bought* | Wholesale prices of all commodities† | Fertilizer material‡ | Chemical ammoniates | Organic ammoniates | Superphosphate | Potash** |
|---|---|---|---|---|---|---|---|---|
| 1930..... | 125 | 140 | 126 | 105 | 72 | 131 | 101 | 99 |
| 1931..... | 87 | 119 | 107 | 83 | 62 | 83 | 90 | 99 |
| 1932..... | 65 | 102 | 95 | 71 | 46 | 48 | 85 | 99 |
| 1933..... | 70 | 104 | 96 | 70 | 45 | 71 | 81 | 95 |
| 1934..... | 90 | 118 | 109 | 72 | 47 | 90 | 91 | 72 |
| 1935..... | 109 | 123 | 117 | 70 | 45 | 97 | 92 | 63 |
| 1936..... | 114 | 123 | 118 | 73 | 47 | 107 | 89 | 69 |
| 1937..... | 122 | 130 | 126 | 81 | 50 | 129 | 95 | 75 |
| 1938..... | 97 | 122 | 115 | 78 | 52 | 101 | 92 | 77 |
| 1939..... | 95 | 121 | 112 | 79 | 51 | 119 | 89 | 77 |
| 1940..... | 100 | 122 | 115 | 80 | 52 | 114 | 96 | 77 |
| 1941..... | 124 | 130 | 127 | 86 | 56 | 130 | 120 | 77 |
| 1942..... | 159 | 149 | 144 | 93 | 57 | 161 | 112 | 77 |
| 1943..... | 193 | 165 | 151 | 94 | 57 | 160 | 117 | 77 |
| 1944..... | 197 | 174 | 152 | 96 | 57 | 174 | 120 | 76 |
| 1945..... | 207 | 180 | 154 | 97 | 57 | 175 | 121 | 76 |
| 1946..... | 236 | 197 | 177 | 107 | 62 | 240 | 125 | 75 |
| 1947..... | 276 | 231 | 222 | 130 | 74 | 362 | 139 | 72 |
| 1948..... | 287 | 250 | 241 | 134 | 89 | 314 | 143 | 70 |
| 1949..... | 250 | 240 | 226 | 137 | 99 | 319 | 144 | 70 |
| 1950..... | 258 | 246 | 232 | 132 | 89 | 314 | 142 | 72 |
| 1951..... | 302 | 271 | 258 | 139 | 93 | 331 | 152 | 76 |
| 1952..... | 288 | 273 | 251 | 144 | 98 | 333 | 158 | 76 |
| 1953..... | 258 | 262 | 247 | 139 | 100 | 269 | 164 | 77 |
| 1954..... | 249 | 264 | 248 | 142 | 95 | 311 | 167 | 76 |
| 1955 | | | | | | | | |
| March.... | 244 | 265 | 248 | 137 | 93 | 275 | 167 | 77 |
| April..... | 247 | 265 | 248 | 135 | 93 | 252 | 167 | 77 |
| May..... | 244 | 263 | 248 | 134 | 93 | 243 | 167 | 77 |
| June..... | 243 | 263 | 248 | 131 | 90 | 242 | 167 | 70 |
| July..... | 237 | 262 | 248 | 132 | 90 | 240 | 167 | 74 |
| August.... | 233 | 260 | 248 | 133 | 91 | 252 | 167 | 74 |
| September. | 235 | 259 | 250 | 132 | 91 | 244 | 167 | 74 |
| October... | 230 | 261 | 250 | 134 | 91 | 259 | 167 | 74 |
| November. | 225 | 259 | 250 | 131 | 91 | 235 | 167 | 74 |
| December.. | 223 | 259 | 250 | 132 | 92 | 232 | 167 | 74 |
| 1956 | | | | | | | | |
| January... | 226 | 259 | 252 | 132 | 92 | 232 | 167 | 74 |
| February.. | 226 | 259 | 252 | 131 | 92 | 225 | 167 | 74 |

* U. S. D. A. figures, revised January 1950. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

**[1] Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.**

**[2] Potash salts quoted F.O.B. mines; manure salts since June 1941; other carriers since June 1947. Beginning June 1954, muriate of potash quoted on both mine and port basis.**

**** Where range of prices for fertilizer material is quoted, average figure is used. The weighted average of prices actually paid for potash is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period.**

# REVIEWS

**This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.**

## Fertilizers

*"General Fertilizer Recommendations for Alabama," Agr. Exp. Sta., Ala. Polytechnic Institute, Auburn, Ala., Sp. Leaf., Sept. 1955.*

*"Fertilizers for 1956 for New Brunswick," Maritime Fertilizer Council, Moncton, N. B., Canada.*

*"Fertilizers for 1956 for Nova Scotia," Maritime Fertilizer Council, Moncton, N. B., Canada.*

*"Fertilizers for 1956 for Prince Edward Island," Maritime Fertilizer Council, Moncton, N. B., Canada.*

*"Analyses of Official Fertilizer Samples by the Feed and Fertilizer Department, Spring Season January-June 1955," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., Reg. Bul. 124, Nov. 1955.*

*"Crop and Fertilizer Recommendations for Mississippi," Agr. Exp. Sta., Miss. State College, State College, Miss., Cir. 199, Jan. 1956.*

*"Fertilizer Experiments on Native Subirrigated Meadows in Nebraska, 1955," Agr. Exp. Sta., Univ. of Nebr., Lincoln, Nebr., Outstate Test. Cir. 50, Dec. 1955, E. M. Brouse, P. L. Ehlers, and G. Viehmeyer.*

*"Fertilizer Recommendations," Agr. Ext. Serv., N. C. State College, Raleigh, N. C.*

*"Charts and Maps Showing Fertilizer Consumption in Oklahoma, 1954-55," Okla. State Board of Agr., Okla. City 5, Okla.*

*"Fertilizer Recommendations for Field and Vegetable Crops, South Carolina, 1956," Agr. Exp. Sta., Clemson Agr. College, Clemson, S. C., Cir. 103, Jan. 1956.*

*"Cotton Fertilizer Test, Lower Rio Grande Valley, 1955," Agr. Exp. Sta., Texas A. & M. College, College Station, Texas, Prog. Rpt. 1832, Dec. 14, 1955, C. A. Burleson, W. R. Cowley, and G. Otey.*

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*"Nitrogen Requirements of Coastal Bermudagrass Under Supplemental Irrigation At College Station," Agr. Exp. Sta., Texas A. & M. College, College Station, Texas, Prog. Rpt. 1837, Dec. 20, 1955, F. L. Fisher, A. G. Caldwell, and J. F. Fudge.*

*"Fertilizer Placement for Tobacco," Va. Polytechnic Institute, Blacksburg, Va., Leaf. No. 32, March 1955.*

*"The Effect of Rate and Frequency of Phosphate Application on Pasture Production," Agr. Exp. Sta., W. Va. University, Morgantown, W. Va., Bul. 380, June 1955, F. W. Schaller and G. G. Pohlman.*

## Soils

*"Irrigation in Western Kansas," Agr. Exp. Sta., Kansas State College, Manhattan, Kans., Cir. 324, Aug. 1955, A. B. Erhart, W. R. Meyer, and B. L. Grover.*

*"Fertility Status of North Carolina Soils—II," N. C. Dept. of Agr., Raleigh, N. C., Nov. 1955, C. D. Welch and G. D. McCart.*

## Crops

*"Small Grain Varities for Alabama, A Report of 1955 Variety Tests," Agr. Exp. Sta., Ala. Polytechnic Institute, Auburn, Ala., Aug. 1955.*

*"Growing Potatoes in Arizona," Agr. Exp. Sta., Univ. of Arizona, Tucson, Ariz., Bul. 269, Dec. 1955, W. D. Pew and R. B. Marlatt.*

*"Foliar Analysis Results from 40 Connecticut Orchards . . . an Evaluation," Agr. Exp. Sta., Univ. of Conn., Storrs, Conn., Bul. 317, Nov. 1955, F. H. Emmert.*

*"A 14-Year Study of Vegetable Crop Rotations on Merrimac Fine Sandy Loam Soil in Connecticut," Agr. Exp. Sta., Univ. of Conn., Storrs, Conn., Bul. 319, March 1955, B. E. Janes, W. O. Drinkwater, G. Beal, J. Scarchuk, and J. M. Lent.*

*"Experiments with Napier Grass," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Bul. 568, Sept. 1955, R. E. Blaser, G. E. Ritchey, W. G. Kirk, and P. T. D. Arnold.*

*"Growing Early Tomatoes," Agr. Ext. Serv., Purdue Univ., Lafayette, Ind., Ext. Leaf. 377, 1955, W. B. Ward.*

*"You Can Profit by Band Seeding," Agr. Ext. Serv., Purdue Univ., Lafayette, Ind., Ext. Leaf. 381, 1955, C. L. Hill and L. H. Smith.*

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*"Growing Sweet Corn for Processing," Agr. Ext. Serv., Univ. of Md., College Park, Md., Ext. Bul. 139, June 1955, F. C. Stark and I. C. Haut.*

*"Vegetable Planting Guide for Louisiana," La. State Univ., Baton Rouge, La., Agr. Ext. Pub. 1185, May 1955.*

*"How to Cultivate Tomatoes," Agr. Ext. Serv., Univ. of Md., College Park, Md., Fact Sheet 29, Rev. May 1955, F. C. Stark and A. A. Duncan.*

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*"Evergreens," Agr. Ext. Serv., Univ. of Minn., St. Paul, Minn., Ext. Bul. 258, Rev. Jan. 1956, R. J. Stadtherr, M. E. Smith, A. C. Hodson, and D. W. French.*

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*"Mineral Nutrition and Growth of Eastern Redcedar in Missouri," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Res. Bul. 577, Feb. 1955, P. W. Fletcher and J. Ochrymowych.*

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*"What Your Missouri Agricultural Experiment Station Did in 1953-54 for You!" Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Bul. 663, Oct. 1955.*

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*"Performance of Grain Sorghum and Millet Varieties in Nebraska, 1955," Agr. Exp. Sta., Univ. of Nebr., Lincoln, Nebr., Outstate Test. Cir. 49, Dec. 1955, O. J. Webster, P. L. Ehlers, R. E. Anderson, and A. F. Dreier.*

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*"Growing Strawberries for Home Use," Agr. Ext. Serv., Cornell Univ., Ithaca, N. Y., Bul. 943, Aug. 1955, E. G. Fisher.*

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*"4-H Small Grains Manual," Agr. Ext. Serv., Okla. A. & M. College, Stillwater, Okla., Cir. 469, Rev. July 1955.*

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*"Growing Cucumbers for Pickling," Agr. Ext. Serv., Univ. of Wis., Madison, Wis., Cir. 503, Aug. 1955, J. A. Schoenemann and O. B. Combs.*

*"Spring Bulbs," Agr. Ext. Serv., Univ. of Wis., Madison, Wis., Cir. 504, Sept. 1955, L. M. Berninger and G. E. Beck.*

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*"Grass for Conservation in the Southern Great Plains," U. S. Dept. of Agr., Wash., D. C., Farmers' Bul. 2093, B. W. Allred and W. M. Nixon.*

### Economics

*"Economics of Pastures in Feeding Systems for Dairy Cows," Agr. Exp. Sta., Ala. Polytechnic Institute, Auburn, Ala., Bul. 296, June 1955, W. F. Gregory.*

*"Arizona Agriculture, 1956, Farm Income, Expenses & Returns for Management on 160-Acre Pump Irrigated Farm in Central Arizona," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Bul. 270, Jan. 1956, G. W. Barr.*

*"Prices Received and Paid by Mississippi Farmers and Index of Seasonal Variation in Farm Prices 1910-1955," Agr. Exp. Sta., Miss. State College, State College, Miss., Bul. 535, Aug. 1955.*

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*"Production, Harvesting, and Marketing of Grains on Individual Farms in South Carolina," Agr. Ext. Serv., Clemson Agr. College, Clemson, S. C., Cir. 401, Feb. 1955, E. W. Siedschlag.*

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## Some Contributions of Recent Plant Introductions . . .

(*From page* 15)

breeding techniques the sorghums we know today bear only faint resemblance to the tall-growing varieties first used. Strains recently introduced are still contributing to the breeding programs in the sorghum-producing areas. One such introduction is the Ladore variety from India, which has a property that may be of value in reducing bird infestation, often a serious problem in sorghum production. J. B. Seiglinger of the Oklahoma Station and R. E. Karper of the Texas Station found this variety to be a yellow-seeded type with growth characteristics similar to those of Hegari, but carrying in the developing seed a bitter principle that makes birds completely avoid it. Upon ripening, this bitter quality disappears, and if birds are numerous, they will eat the grain when they discover the absence of bitterness. This characteristic at least offers temporary protection and is now being used as breeding lines in both States mentioned.

Sorghum breeders have long felt that yellow-endosperm types of sorghum could be found which would aid in overcoming some of the prejudice against sorghum because of its low carotene content. This confidence was rewarded by the introduction of several yellow-endosperm types collected in Nigeria and the Anglo-Egyptian Sudan by O. W. Webster of Nebraska. All of these are too late in maturity to be grown in this country, but unquestionably represent one of the most important introductions in recent years. Several Southern states have assisted in increasing and evaluating these introductions, and crosses made by Mr. Webster when in Nigeria found immediate use among sorghum breeders.

Introductions are occasionally found

to be satisfactory varieties for our use without modification. Sart, a sweet sorghum which was released by the Mississippi Station in 1951, represents such an instance. This variety from the Anglo-Egyptian Sudan is replacing older syrup varieties such as Hodo and Tracy. In Mississippi tests, Sart outyielded its nearest competitor, Hodo, by 35 gallons per acre.

## Legume Introductions

### Alfalfa, *Medicago sativa*

Nearly all breeding work with alfalfa has been confined to the Northern States and little has been done to develop varieties specifically adapted to the South.

Work with several Turkish introductions is in progress at the Oklahoma Station directed toward the development of a pasture type alfalfa for the Southern Great Plains. Some of these were found to be semi-prostrate, to have branched roots, and to be fair seed producers. Having survived severe overgrazing by jack rabbits, they appear well suited to grazing. Tests on these are being conducted in various parts of the State.

### Bur clover, *Medicago* spp.

Although considered valuable from the standpoint of their volunteering habit, bur clovers have been considered objectionable for various reasons. The Texas Station is now concentrating on several smooth-bur types. One of these from Ireland was first tested in 1946, and was found to be earlier and more productive than other bur clovers. Its added feature of retaining burs on the plant makes seed harvest easier. Because it is a valuable replacement for common bur clovers, it is now being increased for certification. Work with two other promising smooth-bur types is still in its preliminary stage.

### Lupine, *Lupinus* spp.

Lupines were first introduced into the United States in 1857, but the crop was not considered successful until tried in Georgia and Florida in 1930.

Plantings have been almost entirely of the high-alkaloid, or bitter-blue type. Low-alkaloid strains suitable for grazing have been introduced on different occasions, and selections have been made for low-alkaloid strains. None of these was found to breed true, and disease susceptibility increased when such selections were made.

In 1950 a blue lupine from Sweden with a varietal designation "Bore" was given extensive trials and is considered valuable enough without further selection to be released by the Georgia and Florida Experiment Stations and the federal Agricultural Research Service as a variety. Seed should be commercially available for planting in the fall of 1955. This strain is a true-breeding blue lupine with the same degree of disease resistance as bitter blue. It has a soft-seeded characteristic not found in other selections. Consequently, better stands are obtained at the same rates of seeding.

A hardy white lupine introduction from Turkey is now in the breeding program at the Georgia Station in an attempt to extend the northern limit of this species. Another from Holland is now being increased at the Mississippi Station for future release. Another white introduction from Germany is being investigated by the North Florida Experiment Station as a possible hog feed because of its high production of palatable seed.

### Peanuts, *Arachis* spp.

Because peanuts originated in South America, all of our peanut varieties have depended on that source for their improvement. Several new introductions have resulted in varieties recently released or in the process of increase for release. A Spanish peanut from Argentina, introduced in 1937, has been tested since its introduction at the Oklahoma Station and was released as the Argentine variety in 1951. According to Oklahoma reports, if the

Argentine and one other high-producing variety were grown on one half of the 220,000 acres of peanut land in the state, additional income to the extent of $1,544,000 per year would result, even though only half the increased yields in tests were realized under average farm conditions.

An occasional introduction, which by itself appears to have no value, may impart unusual results when used in crosses. Another peanut introduction from Argentina, which in itself represented a rather poor type with low yields and no evidence of disease resistance, when crossed on the Virginia bunch in North Carolina, resulted in progeny which appear immune or highly resistant to leafspot diseases and yielded 15% higher than other peanuts in the Station tests. Unfortunately, a varietal release has been delayed because of nematode susceptibility.

## The Value of Green Manure Crops . . .

(*From page* 22)

grass. Field P-3A, measured April 24, 1954, had a larger content of organic matter than Field C-89, measured and plowed almost three weeks earlier. It requires about three weeks after growth begins for the fertilized plots to accumulate the fertility through added growth and quality. Except for bromegrass in P-3A, fall application of nitrogen was about equivalent to that of the spring application. (Tables I and II.)

### Quality—An Essential Measure of Cover and Green Manure Crops

Quality in the cover crop is an essential measurement of value. When the

TABLE IV.—NUTRIENT COMPOSITION IN PER CENT DRY WEIGHT IN COVER CROP FOLIAGES WITH VARIOUS NITROGEN TREATMENTS. (FIELD C-89) 4/26/54

| Treatment | Ryegrass | Rye | Wheat | Barley | Average |
|---|---|---|---|---|---|
| **Nitrogen (per cent)** | | | | | |
| No nitrogen | .58 | .65 | .88 | .90 | .75 |
| 60 lbs. N | .97 | .84 | 1.31 | 1.92 | 1.26 |
| 120 lbs. N | 1.63 | 1.43 | 2.10 | 2.75 | 1.98 |
| Mixture grass | .99 | .63 | .85 | 1.03 | .88 |
| Mixture clover | 2.42 | 2.78 | 2.64 | 2.93 | 2.69 |
| **Phosphorus (per cent)** | | | | | |
| No nitrogen | .22 | .25 | .40 | .36 | .31 |
| 60 lbs. N | .35 | .34 | .49 | .34 | .38 |
| 120 lbs. N | .48 | .40 | .58 | .36 | .46 |
| Mixture grass | .36 | .34 | .40 | .30 | .35 |
| Mixture clover | .36 | .43 | .39 | .43 | .40 |
| **Potassium (per cent)** | | | | | |
| No nitrogen | 3.23 | 1.81 | 3.22 | 4.41 | 3.16 |
| 60 lbs. N | 3.79 | 2.73 | 3.67 | 5.22 | 3.85 |
| 120 lbs. N | 4.90 | 3.75 | 5.84 | 5.54 | 5.01 |
| Mixture grass | 4.75 | 2.94 | 4.20 | 4.41 | 4.07 |
| Mixture clover | 3.70 | 4.83 | 4.28 | 5.83 | 4.66 |

quality is low, the cover or green manure crop competes with the following cash crop for plant food during its decomposition. In such cases the yield of the following cash crop is usually decreased unless the discrepancy is provided for in an extra amount of applied fertilizer. Ordinarily quality is measured in terms of per cent of nitrogen in the dry matter. Phosphorus, potash, calcium, magnesium, and minor elements are also important. To obtain this quality, the application of nitrogen is usually essential for all the grasses grown unless crimson clover or some legume equivalent to the crimson clover is grown as a companion crop. The desired quality required 120 lbs. nitrogen in 1954 for the grasses alone, but 60 lbs. nitrogen were sufficient in 1955. This was due to the greater residue from the preceding cash crop in 1955. Crimson clover as a companion crop was approximately equivalent to 60 lbs. nitrogen when combined with the companion grass.

Cover crops are not ordinarily grown so as to obtain quality. This has frequently produced lower yields for the following cash crop. Because of these experiences, cover and green manure crops have never been properly appreciated and used in our farm practice. The soil conservationist has always rec-

TABLE V.—NUTRIENT COMPOSITION IN PER CENT DRY WEIGHT IN COVER CROP FOLIAGES WITH VARIOUS NITROGEN TREATMENTS SHOWING EFFECT OF THE PREVIOUS YEAR'S TREATMENT, THE ACCUMULATIVE AND CURRENT EFFECT BEFORE NITROGEN APPLICATION, AND 26 DAYS AFTER NITROGEN APPLICATION. (FIELD C-89) 1955

| Treatment* | Ryegrass | | Rye | | Wheat | | Barley | | Orchard-grass | | Average | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3/9 | 4/5 | 3/9 | 4/5 | 3/9 | 4/5 | 3/9 | 4/5 | 3/9 | 4/5 | 3/9 | 4/5 |
| **Nitrogen (per cent)** | | | | | | | | | | | | |
| No nitrogen | 1.26 | .70 | 1.29 | .82 | 1.61 | 1.19 | 1.29 | .80 | 1.39 | 1.04 | 1.39 | .91 |
| 60 lbs. N. | 1.13 | 1.82 | 1.47 | 2.06 | 1.68 | 2.30 | 1.45 | 2.12 | 1.53 | 2.89 | 1.45 | 2.24 |
| 120 lbs. N. | 2.07 | 3.02 | 1.53 | 3.00 | 1.93 | 2.48 | 1.55 | 2.99 | 1.68 | 4.04 | 1.75 | 3.01 |
| Mixture grass | 2.13 | 1.65 | 1.50 | .99 | 1.49 | 1.24 | 1.85 | .84 | 1.86 | 1.45 | 1.76 | 1.23 |
| Mixture clover | ..... | 2.88 | ..... | 2.03 | ..... | 2.61 | ..... | 1.99 | ..... | 2.25 | ..... | 2.35 |
| **Phosphorus (per cent)** | | | | | | | | | | | | |
| No nitrogen | .26 | .23 | .28 | .26 | .37 | .31 | .24 | .22 | .31 | .33 | .29 | .27 |
| 60 lbs. N. | .28 | .38 | .29 | .37 | .34 | .44 | .28 | .28 | .32 | .43 | .30 | .38 |
| 120 lbs. N. | .32 | .41 | .30 | .42 | .40 | .44 | .28 | .32 | .33 | .43 | .33 | .40 |
| Mixture grass | .31 | .34 | .34 | .28 | .37 | .33 | .32 | .26 | .34 | .36 | .34 | .31 |
| Mixture clover | ..... | .38 | ..... | .33 | ..... | .36 | ..... | .37 | ..... | .36 | ..... | .36 |
| **Potassium (per cent)** | | | | | | | | | | | | |
| No nitrogen | 1.61 | 1.63 | .86 | 1.21 | 1.49 | 1.80 | 1.88 | 1.80 | 1.24 | 2.78 | 1.42 | 1.84 |
| 60 lbs. N. | 1.51 | 2.96 | 1.12 | 2.19 | 1.74 | 2.87 | 2.23 | 3.04 | 1.70 | 4.01 | 1.53 | 3.02 |
| 120 lbs. N. | 2.10 | 3.28 | 1.28 | 3.51 | 2.21 | 3.14 | 2.42 | 3.54 | 1.79 | 5.05 | 1.96 | 3.70 |
| Mixture grass | 2.54 | 3.02 | 1.44 | 1.80 | 2.74 | 2.64 | 2.71 | 2.49 | 2.00 | 3.68 | 2.29 | 2.73 |
| Mixture clover | ..... | 1.60 | ..... | 2.30 | ..... | 3.91 | ..... | 3.35 | ..... | 2.94 | ..... | 2.82 |

* Second year nitrogen applications on March 10, 1955.

TABLE VI.—PER CENT NITROGEN, PHOSPHORUS, AND POTASSIUM IN THE COVER CROPS WITH VARIOUS TREATMENTS. (P-3A) 4/24/55

| Treatments | Rye-grass | Rye | Wheat | Barley | Orchard-grass | Brome-grass | Average |
|---|---|---|---|---|---|---|---|
| **Nitrogen (per cent dry wt.)** | | | | | | | |
| No nitrogen | 1.40 | 0.58 | 1.18 | 0.82 | 1.33 | 1.87 | 1.20 |
| 60 lbs. " (Fall) | 1.84 | 0.96 | 1.35 | 1.12 | 1.36 | 1.98 | 1.43 |
| " " " (Spring | 1.61 | 1.17 | 1.57 | 1.60 | 2.40 | 2.27 | 1.77 |
| 120 " " (Fall) | 1.68 | 1.07 | 1.51 | 1.42 | 2.03 | 2.84 | 1.76 |
| " " " (Spring) | 2.73 | 1.18 | 2.02 | 1.99 | 2.67 | 2.79 | 2.23 |
| Mixture— | 1.13 | .81 | .97 | .98 | 1.52 | 1.69 | 1.18 |
| with c. clover | 2.22 | ..... | 2.40 | 2.23 | 2.69 | 2.41 | 2.39 |
| **Phosphorus (per cent dry wt.)** | | | | | | | |
| No nitrogen | .36 | .21 | .32 | .26 | .36 | .37 | .31 |
| 60 lbs. " (Fall) | .42 | .31 | .33 | .28 | .37 | .38 | .35 |
| " " " (Spring) | .41 | .32 | .35 | .31 | .44 | .43 | .38 |
| 120 " " (Fall) | .43 | .38 | .34 | .31 | .43 | .40 | .38 |
| " " " (Spring) | .48 | .31 | .39 | .32 | .46 | .45 | .40 |
| Mixture— | .32 | .26 | .31 | .29 | .44 | .41 | .34 |
| with c. clover | .36 | ..... | .33 | .35 | .41 | .34 | .36 |
| **Potassium (per cent dry wt.)** | | | | | | | |
| No nitrogen | 3.63 | 1.54 | 2.84 | 3.50 | 4.67 | 3.85 | 3.33 |
| 60 lbs. " (Fall) | 4.78 | 2.60 | 3.46 | 3.54 | 4.59 | 3.73 | 3.78 |
| " " " (Spring) | 5.25 | 2.49 | 4.12 | 3.85 | 4.68 | 4.41 | 4.13 |
| 120 " " (Fall) | 5.00 | 3.33 | 3.34 | 3.48 | 5.92 | 4.93 | 4.33 |
| " " " (Spring) | 5.21 | 3.26 | 3.20 | 3.07 | 5.54 | 4.75 | 4.17 |
| Mixture— | 4.62 | 2.33 | 2.86 | 4.39 | 5.92 | 4.08 | 4.03 |
| with c. clover | 3.59 | ..... | 2.94 | 4.26 | 3.19 | 2.34 | 3.26 |

ommended their use. The proponents of soil fertility are usually divided, or prefer planned rotations. We have too few measures with which to compare the value of cover and green manure crops with rotations. These measures include nutrients, their availability, influence on soil structure, soil aeration, moisture-holding capacity, and microbial activity. We still need to know how to select and grow cover crops. In addition, we should be breeding the kind of cover crop we need, the same as we are breeding better cash crops. (Tables III, IV, V, VI.)

(*To Be Continued, April Issue*)

## The Application of Fertilizers . . .

(*From page* 10)

irrigated. The water used was fairly high in total salts, especially sulfate, and the sprinkled section showed much more salt injury than the furrow irrigated. Soil analyses in the two sections showed a much greater build-up of salt in the sprinkler irrigated area than in the furrow irrigated area. Since additions of fertilizer to water will increase the total soluble solids, this point

TABLE II.—DECREASE IN AMMONIA NITROGEN CONCENTRATION FROM HEAD TO FOOT OF FURROW IN VARIOUS CALIFORNIA CITRUS ORCHARDS WHERE AMMONIA GAS USED.

| Location | Date of sampling | Time of day sample taken | Length of time prior to sampling. $NH_3$ had been added to irrigation water | Ammonia concentration (ppm. N) at various distances from head of furrow | | | | Temperature of water degrees F | Flow rate in furrow | Wind |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | At irrigation outlet (head of furrow) ppm. N | Down furrow | | | | | |
| | | | | | Distance down furrow from outlet | ppm. N | Per cent decrease in concentration | | | |
| Hopkins | 9/ 2/44 | 4:00 PM | 33 hours | 36.9 | 300 ft. | 25.8 | 30.1 | 70.8–76.2 [1] | Slow | None |
| Hopkins | 9/ 2/44 | 8:00 AM | 22 hours | 30.4 | 300 ft. | 23.6 | 21.6 | 68.8–64.6 | Slow | None |
| Kimmell | 10/ 1/43 | 1:00 PM | 9.5 hours | 59.2 | 280 ft. | 27.9 | 52.6 | 75.3–82.5 | Slow | None |
| Minor | 10/ 1/43 | 3:00 PM | 25 hours | 33.6 | 240 ft. | 28.5 | 15.2 | 69.8–84.2 | Slow | Slight |
| Holden | 8/31/44 | 8:00 AM | 68 hours | 68.4 | 200 ft. | 60.0 | 12.2 | 67.8–64.5 | Moderate to slow | None |
| Holden | 8/30/44 | 4:00 PM | 54 hours | 44.0 | 200 ft. | 36.1 | 18.0 | 74.0–84.0 | Moderate to slow | 15–18 mi. per hr. |
| Frost | 7/27/43 | 10:40 AM | 2 hours | 33.9 | 270 ft. | 33.6 | 0.8 | 66.2–73.4 | Fast | Very little |
| Dudley | 7/26/43 | 10:30 AM | 3.5 hours | 37.9 | 280 ft. | 35.3 | 6.8 | 69.8–78.8 | Fast | Very little |
| Arrowsmith | 7/25/43 | 3:00 PM | 2.0 hours | 47.8 | 440 ft. | 36.4 | 23.8 | 71.6–91.4 | Rapid | Slight |
| Fletcher | 9/ 9/44 | 4:40 PM | 32.0 hours | 42.5 | 300 ft. | 38.4 | 9.6 | 75.5–76.5 | Rapid | None |
| Fletcher | 9/ 9/44 | 5:30 AM | 23.0 hours | 26.0 | 300 ft. | 26.4 | None | 76.0–72.0 | Rapid | None |

[1] First figure is temperature at head of furrow and second is temperature at point of sampling down furrow.

TABLE III.—POUNDS OF FERTILIZER APPLIED PER ACRE AT VARIOUS CONCENTRATIONS IN IRRIGATION WATER AND WITH DIFFERENT RATES OF WATER.

| Acre-inches of water applied | Pound per acre applied at different concentrations | | | | |
|---|---|---|---|---|---|
| | 10 ppm. | 20 ppm. | 30 ppm. | 40 ppm. | 50 ppm. |
| 1 | 2.26 | 4.53 | 6.80 | 9.06 | 11.33 |
| 2 | 4.53 | 9.06 | 13.60 | 18.12 | 22.66 |
| 3 | 6.80 | 13.56 | 20.40 | 27.18 | 33.99 |
| 4 | 9.06 | 18.08 | 27.20 | 36.24 | 45.32 |
| 5 | 11.33 | 22.65 | 34.00 | 45.30 | 56.65 |
| 6 | 13.60 | 27.20 | 40.80 | 54.40 | 67.98 |
| 7 | 15.86 | 31.71 | 47.60 | 63.42 | 79.31 |
| 8 | 18.10 | 36.24 | 54.40 | 72.48 | 90.60 |
| 9 | 20.40 | 40.77 | 61.20 | 81.54 | 101.97 |
| 10 | 22.66 | 45.30 | 68.00 | 90.60 | 113.30 |
| 11 | 24.92 | 49.83 | 74.80 | 99.66 | 124.63 |
| 12 | 27.12 | 54.36 | 81.60 | 108.72 | 135.96 |

is mentioned in passing as something to watch for under sprinkler irrigation.

Recent studies by Henderson, Bianchi, and Doneen of the Department of Irrigation at Davis, California, show large volatilization losses of ammonia from sprinkler systems. If, however, the pH of the irrigation water is kept at pH 7 or below, little or no loss will result.

### Rates of Application

Since it is possible to split fertilizer applications when made in irrigation water, it is generally advisable to keep the concentration of added fertilizer below 100 ppm. In Table III are shown the amounts of fertilizer applied per acre at variable irrigation rates and concentrations of fertilizer. For example, if one is applying 4 acre-inches of water per irrigation, it would be possible to apply 45.3 pounds of dissolved fertilizer per acre where the concentration is kept down to 50 ppm.

In Table IV are shown the flow rates of two typical liquid fertilizers necessary to apply 100 pounds of nitrogen per acre in a 24-hour run. With a 20% ammonia solution it would be necessary to discharge this at a rate of 2.74 gallons per hour or 172.8 cc. per minute in order to apply 100 pounds of nitrogen per acre in 24 hours. The resulting concentration in the irrigation water would amount to 23.0 ppm. where the flow rate is 40 So. Calif. miner's inches. From these Tables it is easy to calculate with any given fertilizer solution the flow rate necessary to apply a given amount of fertilizer per acre in a given period.

### Efficiency

No precise data are available as to the efficiency of fertilizer usage when applied to irrigation waters. However, a recent study of nitrogen fertilizer practices in California citrus orchards made by Aldrich and Taylor (1) has shown that many citrus groves are being successfully maintained with the use of only 1.5 pounds nitrogen per tree per year where the nitrogen is applied in split doses to irrigation water as against an apparent average requirement of 2 to 4 pounds where the material is applied by conventional methods.

It is, of course, evident that better control as regards timing, rate, and avoidance of root injury can be had by the use of liquid fertilizer or additions to irrigation water. In general, labor saving, timing and control, and reduction in traffic are among the more important advantages of the method.

TABLE IV.—FLOW RATE OF TYPICAL LIQUID FERTILIZER.

| Flow rate of irrigation water | | | | Flow rate of typical liquid fertilizers necessary to apply 100 lbs. N per acre in 24 hours and resulting concentration of N in irrigation water | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 20% N ammonia solution [1] (1 gal. contains 1.52 lbs. N) | | | | 10% N, 10% $P_2O_5$, 5% $K_2O$ [2] (1 gal. contains 1.07 lbs. N, 1.07 lbs. $P_2O_5$, and 0.53 lbs. $K_2O$) | | | |
| | | | | | | Resulting conc. in irrigation water | | | | Resulting concentration in irrigation water | | |
| So. Calif. miner's inches | gals./min. | Cu. ft. sec. | Acre-inches in 24 hrs. | gals./hr. | cc./min. | ppm. N | gals./hr. | cc./min. | ppm. N | ppm. $P_2O_5$ | ppm. $K_2O$ |
| 10.0 | 89.8 | 0.2 | 0.475 | 2.74 | 172.8 | 92.6 | 3.90 | 246.0 | 92.6 | 92.6 | 46.2 |
| 20.0 | 179.6 | 0.4 | 0.950 | 2.74 | 172.8 | 46.2 | 3.90 | 246.0 | 46.2 | 46.2 | 23.0 |
| 30.0 | 269.4 | 0.6 | 1.425 | 2.74 | 172.8 | 30.8 | 3.90 | 246.0 | 30.8 | 30.8 | 15.4 |
| 40.0 | 359.2 | 0.8 | 1.900 | 2.74 | 172.8 | 23.0 | 3.90 | 246.0 | 23.0 | 23.0 | 11.4 |
| 50.0 | 449.0 | 1.0 | 2.375 | 2.74 | 172.8 | 18.8 | 3.90 | 246.0 | 18.4 | 18.4 | 9.2 |
| 60.0 | 538.8 | 1.2 | 2.850 | 2.74 | 172.8 | 15.4 | 3.90 | 246.0 | 15.4 | 15.4 | 7.6 |
| 70.0 | 628.6 | 1.4 | 3.320 | 2.74 | 172.8 | 13.2 | 3.90 | 246.0 | 13.2 | 13.2 | 6.6 |
| 100.0 | 898.8 | 2.0 | 4.750 | 2.74 | 172.8 | 9.2 | 3.90 | 246.0 | 9.2 | 9.2 | 4.6 |

[1] Density 7.60 lbs. per gallon
[2] Density 10.46 lbs. per gallon


## Summary

There has been a spectacular increase in the application of fertilizers to irrigation water in California and irrigated regions of the West in recent years.

At present there are some 82 different registrants marketing liquid fertilizers in California and some 200 different brand names are on the market. It is possible now to buy not only straight nitrogen solutions made of such materials as ammonium nitrate, urea, ammonium hydroxide, etc., but phosphoric acid, potash in solution, and many different combinations including a considerable number made from fish wastes. Methods of application vary all the way from simply dumping sacks of soluble dry fertilizers into weir boxes or canal laterals, to the use of many different kinds of tanks containing stock solutions with suitable devices for metering the fertilizer solution into the irrigation supply. Devices are also available for injecting fertilizer solutions into pressure systems.

Problems of pipeline and valve corrosion or deterioration have been partially studied although there is need for more work along this line.

With regard to the uniformity of lateral and vertical distribution, it can be said as a broad generalization that this will be no better than the distribution of water and, under furrow irrigation with the use of ammonium solutions where some volatilization occurs, lateral distribution is in some instances uneven. However, despite some difficulties as regards uniformity of distribution, there are other decided advantages which tend to offset the aforementioned disadvantage. Some of these are as follows:

1—It appears to require less fertilizer to do the job. A survey of nitrogen-usage practices in California citrus orchards has shown that by splitting applications in irrigation water, many growers maintain excellent orchard production with the use of only 1½ lbs. of nitrogen per tree per year as contrasted with the use of double this amount in many other situations.

2—Better control of fertilizer applications can obviously be had from application in irrigation water. Both very small and reasonably large applications can be made, and of course the important element of timing in relation to stage of crop growth is particularly valuable.

3—Injury to plant roots is minimized.

4—Fertilizers in poor physical condition can be used much more advantageously in this manner than in the dry form.

5—Labor reduction.

6—Traffic reduction — in orchards and fields.

Although detailed studies and comparisons are not available, the enormous expansion in this method of fertilizer application indicates that from a practical point of view it works and good results are obtained.

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# Spring Aid for Bluegrass

SPRING fertilization and proper grazing will help offset dry weather damage to permanent pastures. E. P. Reed, Extension Agronomist, Ohio State University, says, "Over-grazing during the spring—before weakened plants have had an opportunity to make some growth and build a root system—will greatly decrease the total production from bluegrass pastures.

"March applications of a straight nitrogen fertilizer or a complete fertilizer high in nitrogen will increase spring growth and offset much of the ill effects of adverse weather during the previous summer and fall." For straight nitrogen, Reed suggests 60 pounds of nitrogen an acre on fields previously treated with phosphate and potash. He suggests 600 pounds an acre of 10-10-10 as a complete fertilizer.

The Agronomist explains that hot, dry weather during summer and fall limits bluegrass recovery following its summer dormancy. A few bluegrass plants may be dead. In most cases however, there are enough rhizomes and buds to maintain a satisfactory stand of bluegrass if it receives care in the spring. Rhizomes are underground stems and one of the methods by which bluegrass spreads.

# Barbadian Agriculture

(*From page* 26)

deterioration of their own land, which usually was the least valuable to begin with, otherwise they could not have secured it.

Most of the island is a gently rolling limestone formation, and although the soil is thin in many places, it is generally productive. Yields of 35 to 40 tons of cane are usually secured on the better land, and, as the percentage of sugar is higher than in most places, this means 4 to 5 tons of sugar per acre.

### Serious Local Erosion Problem

One area of approximately 22 square miles is distinctly different and presents a serious land-use and erosion problem. On this portion of the island the overlying limestone cap has been removed by geologic erosion, leaving exposed a highly erosive soil. The area, known as the Scotland District, lies within four miles of the ocean and as it reaches an elevation exceeding 1,000 feet, the problem of water management is most difficult. The slopes are quite steep, often running to 60 or 65%. The rainfall ranges from 45 to 75 inches and much of it falls as quick torrents. Consequently, erosion in all of its forms is serious.

Sheet erosion occurs wherever rain falls on bare or unprotected ground. Gullies result where there is a concentration of water, and, to add to the difficulty, much of this area consists of a soil formation, which, when saturated with water and especially when undercut by water at the foot of the slope, slips down hill en masse.

The advanced sheet erosion, accompanied by gullying in many places, has resulted in the abandonment of many acres, particularly the steeper hillsides where slippage also is a factor. At present, such land supports only a sparse cover of grass with occasional shrubs. The efforts of the ever-present cows, sheep, and goats to secure nourishment reduces to a minimum the effectiveness of such cover. And, unless protective measures are undertaken on the remaining land in cultivated crops, within a very few years additional acres are destined to be abandoned.

Gullies, in all stages of development from finger-like depressions in cultivated fields to yawning chasms in abandoned areas, are quite common in this area. Efforts made by farmers to remove surface water rapidly, which is essential if slips are not to be encouraged, may actually contribute to the development of additional gullies. On one steep hillside planted to cane, a vertical section had been put in bananas with furrows between adjacent rows plowed directly up and down the slope. Already these drains were being deepened, and the abandonment of the area in bananas is inevitable under the present method of use.

Vegetation seems not to be of any particular advantage in preventing the slippage type of erosion as slips of varying size were noted in well-established cane fields, and at least one on a heavily wooded slope.

Much of the rain in Barbados comes as torrential downpours and when 4 to 6 inches fall within a very few hours, as is not uncommon, it is inevitable that meandering brooks become surging torrents which may change their course and leave much destruction behind.

Such varied and serious types of erosion as are found in the Scotland District of Barbados, and which often are in close relationship one to the other, can be controlled only by bringing into play all appropriate control measures bound together to make a coordinated plan of attack. Engineering devices and structures are needed, but alone they will not do the job. They must be reinforced and supported by vegeta-

tion, heavy duty vegetation such as dense sod, low-growing shrubs, and trees.

Unfortunately the planters until recently did not recognize the need for differential treatment of this area, or they were so sorely pressed by an ever-expanding population that they could not see their way clear to develop a type of use suited to its particular conditions. Consequently, when a hillside became so badly eroded that cane could not be produced profitably, it was abandoned or perhaps made available as home sites to peasants whose ever-present goats and sheep effectively prevent Nature's rehabilitation forces from taking possession.

### Drastic Measures Needed

Now that the trouble has been belatedly recognized, only drastic measures will suffice to control the situation. Undoubtedly many of the steeper areas will have to be withdrawn from cultivation entirely, replanted to trees or shrub-type plants, and men and animals excluded. This means the removal of a considerable number of people, and where they are to go presents a difficult problem.

Accustomed as we Americans are to think in terms of great expanses of territory, it is hard for us to realize that 22 square miles of farm land could be so important. Our first reaction, if faced with a similar problem, would be to say, "Plant it to trees and forget about it for 20 or 30 years."

But when it is realized that this area represents the proportionate amount of land available for some 30,000 people, the solution is not so easy. Some way must be found to use every acre of it at the maximum capacity possible, even taking a calculated risk, as the military leaders say, so as to produce as much food for as many people as possible.

Except for mulching, soil and water conservation measures are not in general use. On the less steep slopes the cane affords sufficient cover to appreciably reduce soil losses to a fairly low

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level, and on the steeper slopes, which constitute most of the area embraced in the Scotland District, but little attention has been paid heretofore to losses by erosion. Frequently rows are run straight up and down hill, even on steep slopes. Many cases are noted where drains or hillside ditches are laid out on a steep grade so as to remove the water quickly. However, under the leadership of the local Department of Agriculture, conservation measures such as contouring and proper water disposal systems, are being developed. Likewise, an appreciable area is being planted to trees each year under a program whereby planting stock is made available at low cost for such purposes. These measures are being recommended throughout the island, but are especially needed in the Scotland District.

The need for careful soil-conserving practices is recognized by many people, as is evidenced by the statement of the manager of one large sugar estate who said, after describing the effective manner in which he had contoured a field after having eliminated two deep gullies by diverting the water which was their cause: "I would not manage any sloping land if not allowed to put in contours."

The need for better land-use practices and erosion control is general throughout Barbados, although the Scotland District represents a particularly critical problem. The hope of a thoroughly practicable plan being put into effect depends, as it does elsewhere, on the aroused interest of the agricultural leaders and the general public. Officials of the Barbadian Department of Agriculture and of the colony as well are thoroughly aware of the urgency of the situation and are making concerted efforts at meeting it. Given adequate financial support and the even more necessary support of public opinion, the situation will be met and solved to the lasting benefit of future generations of Barbadians.

## Soil-conserving Goals

(*From page* 5)

erosion and depletion, the farmers of the Corn Belt would have to cut their corn and oats acreage and add to their soil-building acreage with legumes, hay, and pasture. Southern planters were advised to decrease cotton acreage and also grow legumes and more meadows and plant feed crops other than corn. The wheat acreage of the Great Plains and the Pacific Northwest should be reduced, they advised, and lower yielding land taken out of production. The advice to the farmers of the semi-arid regions was to stabilize the numbers of cattle and sheep at current low levels so as to restore the grass and help check wind erosion.

It was pointed out that the $500 million appropriated annually under the S.C.D.A. law of 1936 equaled a half of one per cent of the national yearly income, and was about the same as five per cent of the value at $50 per acre of the estimated 200 million acres of washed and eroded land.

In one of the circulars of that period 20 years ago, written by Bushrod Allin, it spoke of the numerous classes of farmers who were not naturally inclined to take a long-time future view of soil building. We may now ask ourselves a similar question—even though education has swept across the country since to erect a formidable proportion of our farmers who *do* consider soil conservation in terms of lifetimes. That is, will the soil bank plan of voluntary land withdrawal in partnership with the government appeal to some of the same classes of farmers who are mentioned in the circular issued in May 1936, entitled "Soil Conservation—It's Place in Agricultural Policy"?

It went on to say that much of our

American farm tenancy is short-term tenancy. The land speculator does not want any tenant land-use agreement to interfere too long with his buying and selling operations. He wants to be left free, not hindered by notions. Landlords often do not comprehend the plan to compensate the tenant for making improvements in the land, and similarly, the tenant often has little or no reason for doing so. Unless payments as rental are high enough, the same stalemate will occur, no doubt, and exploitation of farms will continue.

The circular surmised that tenants and absentee landlords are not the only farmers without sufficient long-time zest for improving particular parcels of land. Property-owning farmers of the Midwest have ambitions to retire and go to California or Florida, while others educate their children for nonfarm jobs because the farm won't support all of them—so they are often eager to sell and get away. Still others are looking to make a deal for a better farm than the one they run, rather than stay put and improve the one they have.

THE best reason advanced in support of conservation was that between 1920 and 1933 many farmers who really had a long-time interest in soil conservation were too hard-pressed financially to make the necessary investment. I hope we do not run into that form of barrier if the soil bank plan is passed. Such men depleted their soil and used other capital to meet their necessary fixed charges, always hoping that at some future time they would be able to recoup and put back what they took from the soil. Too many of them failed to realize that dream, until we had a world war to bolster our wavering economy. And even then, many of them wasted their substance producing depleted acreage crops because these paid best while we were girding our loins for war.

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was in high gear—1934 to 1935—more than 10 million acres of cropland per year were shifted from cultivated crops to soil-conserving crops, under adjustment contracts with individual farmers. By 1936 we had three forms of federal subsidy for soil conservation on individual farms. These were the benefit payments of the AAA, the technical services and supplies available from S.C.S., and phosphate fertilizers furnished by the Tennessee Valley Authority.

IT was the belief of the new law's sponsors that a reasonable level of income could not be maintained indefinitely in the worst sub-marginal land areas, except by paying terrifically high and unthinkable subsidies. Here the farms were often too small to form a type of agriculture well suited to saving and restoring the soil. These circumstances still exist and must be considered carefully in any farm program. In other words, the idea of making equal divisions of the federal payments between states runs counter to the sounder plan of avoiding subsidies to owners of land in the bad spots.

In the thirties, authorities stated that heavy subsidies would have been necessary to carry out an immediate land-use program in these severe problem areas, unless at least a couple of million people in these areas could have been moved to cities or to better farms. This solution is not palatable at best, and as one farm paper editor puts it: "The idea is to shift surplus crops into legumes and shift surplus farmers into town." Hard as it often is to deal with soil troubles, it's a blamed sight harder to deal with humanity—and very bunglesome politically besides.

One of the firm declarations in the circular used to justify and clarify the policy embodied in the law of 1936 has a truthful ring to it still:

"American farmers will not live under conditions of stabilized poverty and save the soil at the same time. As long as farmers wish to live like other Americans, they will heavily discount the future in order to do so. The more they discount the future, the less they will save the soil for future generations.

"Any farmer who is unable to meet the present standard of living, whatever that may be, will certainly devote little of his time to saving the soil where it means any sacrifice of present income for this better living."

BUT we know that since that declaration we have organized a vast domain into soil conservation districts. Under the tutelage and leadership of the S.C.S., hosts of farmers who otherwise would not or could not follow systematic soil improvement and restore lands ruined by erosion have had their fellow farmers, the state, and the nation behind them. Thus fortified cooperatively, they have enjoyed good living and enhanced fertility on their homesteads at the same time.

Proposals of the moment under the soil bank plan include two land reserves —one for acreage removal and the other for conservation. The conservation angle is broader than we had in the law of 1936. This is because it permits or suggests transfer of acreage into forage, trees, and farm water reservoirs. In neither the acreage nor the conservation reserve are farmers allowed to graze or harvest off any of the growth. Presumably plow-down is left untouched in the program so soil improvement that way is permissable. The sponsors of the proposed soil bank hope that from 40 to 50 million acres will eventually be taken out of cash crop output.

Some like the whole idea, others reject it. At any rate, we will focus attention again on securing a land reserve dedicated to future soil improvement. If the government can assist producers to make this shift without heavy stress on their incomes in times of high farm expenses and capital investment, all we can say is "more power to them!"

# Naugatuck Agricultural Chemicals

| product | application | advantages |
|---|---|---|
| **Aramite**<br>miticide | controls mites on citrus and deciduous fruits, cotton, other row crops, ornamentals and vine crops. Also controls poultry mites. | non-hazardous, low cost per acre, highly compatible, harmless to natural predators. |
| **Spergon®**<br>seed protectant | controls soil fungi and storage insects (with DDT) on most crop and vegetable seeds. | effective at economical dosages, safe on seed, easy to use, compatible with most other chemicals including legume inoculants, low cost. |
| **Phygon®-XL**<br>fungicide | controls fungus diseases on fruit trees and row crops. | extremely low cost per acre, easy to apply, compatible, harmless to pollen and bees. |
| **MH**<br>growth retardant and herbicide | inhibits grass growth: controls wild onions and quack grass; prevents tobacco suckering. Pre-harvest application prevents destructive storage sprouting of edible onions and potatoes. | extremely safe on plants; easy to apply: in wild onion control, one spray lasts up to 3 years. |
| **Alanap®**<br>pre-emergence weed killer | pre-emergence weed-control for vine, row crops; asparagus and nursery stock. Available commercially for use on vine crops. | safe on recommended crops, relatively non-toxic, easy to apply, favorably priced. |
| **Duraset*-20W**<br>flower and fruit-setting compound<br>*U. S. PAT. 2,556,665 | a fruit-setting chemical for lima beans, legumes, peppers and various tree fruits. | low dosage per acre, easily applied as a foliage spray. |

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## FREE LOAN OF EDUCATIONAL FILMS

**The American Potash Institute will be pleased to loan to educational organizations, agricultural advisory groups, responsible farm associations, and members of the fertilizer trade the motion pictures listed below. This service is free except for shipping charges.**

### FILMS (ALL 16 MM. AND IN COLOR)

The Plant Speaks Thru Deficiency Symptoms (Sound, running time 25 min. on 800-ft. reel.)

The Plant Speaks, Soil Tests Tell Us Why (Sound, running time 10 min. on 400-ft. reel.)

The plant Speaks Thru Tissue Tests (Sound, running time 14 min. on 400-ft. reel.)

The plant Speaks Thru Leaf Analysis (Sound, running time 18 min. on 800-ft. reel.)

Save That Soil (Sound, running time 28 min. on 1200-ft. reel.)

Borax From Desert to Farm (Sound, running time 25 min. on 1200-ft. reel.)

Potash Production in America (Sound, running time 25 min. on 800-ft. reel.)

In the Clover (Sound, running time 25 min. on 800-ft. reel.)

In Canada: The Plant Speaks Thru Deficiency Symptoms
The Plant Speaks, Soil Tests Tell Us Why
The Plant Speaks Thru Tissue Tests
The Plant Speaks Thru Leaf Analysis
Borax From Desert to Farm
Potash Production in America

### DISTRIBUTORS

Northeast: Educational Film Library, Syracuse University, Syracuse 10, N. Y.

Southeast: Vocational Film Library, Department of Agricultural Education North Carolina State College, Raleigh, North Carolina.

Lower Mississippi Valley and Southwest: Bureau of Film Service, Department of Educational Extension, Oklahoma A & M College, Stillwater, Oklahoma.

Midwest: Visual Aid Service, University Extension, University of Illinois, Champaign, Illinois.

West: Department of Visual Education, University of California, Berkeley 4, California.

Department of Visual Education, University of California Extension, 405 Hilgard Ave., Los Angeles 24, California.

Department of Visual Instruction, Oregon State College, Corvallis, Oregon.

Bureau of Visual Teaching, State College of Washington, Pullman, Washington.

Canada: National Film Board, Ottawa, Ontario.

For the Province of Ontario: Distribution Services, Ontario Agricultural College, Guelph, Ontario.

### IMPORTANT

**Requests should be made well in advance and should include information as to group before which the film is to be shown, date of exhibition (alternative dates if possible), and period of loan.**

**Request bookings from your nearest distributor.**

## AVAILABLE LITERATURE

The following literature on the use of fertilizers in profitable soil and crop management is available for distribution. We shall be glad to send these upon request and in reasonable amounts as long as our supply lasts.

### Reprints

3-1-56 Potash In Agriculture
28-12-45 Better Corn (Midwest) (Circular)
F-3-40 When Fertilizing, Consider Plant-food Content of Crops
S-5-40 What is the Matter with Your Soil?
Y-5-43 Value & Limitations of Methods of Diagnosing Plant Nutrient Needs
A-1-44 What's in That Fertilizer Bag?
P-3-45 Balanced Fertility in the Orchard
Z-5-45 Alfalfa—The Aristocrat
ZZ-11-45 First Things First in Soil Fertility
T-4-46 Potash Losses on the Dairy Farm
Y-5-46 Learn Hunger Signs of Crops
TT-11-47 How Different Plant Nutrients Influence Plant Growth
AA-6-48 The Chemical Composition of Agricultural Potash Salts
GG-10-48 Starved Plants Show Their Hunger
SS-12-49 Fertilizing Vegetable Crops
BB-8-50 Trends in Soil Management of Peach Orchards
X-8-51 Orchard Fertilization Ground and Foliage
BB-10-51 Healthy Plants Must Be Well Nourished
II-12-51 Pasture Improvement With 10-10-10 Fertilizer
KK-12-51 Potassium in Animal Nutrition
A-1-52 Research Points the Way to Higher Levels of Peanut Production
Y-10-52 The Nutrition of Muck Crops
CC-12-52 The Leaf Analysis Approach to Crop Nutrition
I-2-53 Sericea Is a Good Drought Crop
J-3-53 Balanced Nutrition Improves Winter Wheat Root Survival
K-3-53 Kudzu Keeps Growing During Droughts
N-4-53 Coastal Bermuda—A Triple-threat Grass on the Cattleman's Team
P-4-53 Learning How to Make Profits from Sweet Potatoes
T-5-53 Trefoil Is Different
W-6-53 The Development of the American Potash Industry
DD-10-53 Sampling Soils for Chemical Tests
II-11-53 The Importance of Legumes in Dairy Pastures
JJ-11-53 Boron—Important to Crops
MM-12-53 White Birch Helps Restore Potash-Deficient Forest Soils
K-2-54 Soil and Plant Analysis Increase Fertilizer Efficiency
R-3-54 Soil Fertility (Basis for High Crop Production)
U-4-54 Nutrient Balance Affects Corn Yield and Stalk Strength
CC-6-54 Fertility Increases Efficiency of Soil Moisture
EE-8-54 Red Apples Require Balanced Nutrition
FF-8-54 Apply Fertilizers in Fall For Old Alfalfa, Grass Pasture and Timothy-Brome Fields
GG-8-54 Effect of Boron on Beets and Crops Which Follow
JJ-10-54 Principles Involved in Soil Testing
LL-10-54 Relation of Fertilizer to Quality and Yield of Flue-cured Tobacco
MM-10-54 Longer Life for Ladino
SS-11-54 Foliar Application of Plant Nutrients to Vegetable Crops
VV-12-54 Potassium Affects Growth of Stocks
YY-12-54 Physical Condition of the Soil Affects Fertilizer Utilization
A-1-55 Potash-Deficiency Symptoms
C-1-55 Summary of Ten Years' Work with Complete Fertilizers on Sugar Cane
D-1-55 Nitrogen Use Accentuates Need for Minerals
G-2-55 Seven Steps to Good Cotton
H-2-55 Apparent Fertility Trends in Western Irrigated Soils
I-2-55 Shortages of Potash Limit Grape Yields
L-3-55 Soybean Production in the Southern States
P-3-55 N-P-K for Deciduous Fruit Trees
R-4-55 Potash Prevents "Curl Leaf" of Sour Cherries
S-4-55 Greener Pastures Mean Better Living
U-4-55 Fertilizer Recommendations—Burley Tobacco
V-4-55 Planned Nutrition for Canning Tomatoes
W-5-55 The Production of Sugar Beets on Organic Soils
X-5-55 What Is Happening to Our Citrus Soils?
Y-5-55 Pasture Improvement Through Renovation
Z-5-55 Azalea Fertilization
BB-8-55 Residual Fertility Insures Alfalfa After Drouth
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B-1-56 Certain Practices Are Important for Successful Pecan Production
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D-2-56 Give Fertilizers A Chance
E-2-56 Fertilizer Statistics From the 1954 Census of Agriculture
F-2-56 Fertility-lime Status of Mississippi Soils
G-2-56 Plant-food Content of Crops—Guide to Rotation Fertilization

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"Now," she said, "is there any man in the audience who would let his wife be slandered and say nothing? If so stand up."

A meek little man rose to his feet.

The lecturer glared at him. "Do you mean to say you would let your wife be slandered and do nothing about it?"

"Oh, I'm sorry," he apologized. "I thought you said slaughtered."

* * *

They were expecting a new baby at the Lamberts', and the secret was growing more difficult to conceal. Finally the father decided the time had come to break the news to his son.

"Bob," began the father "the stork has been flying over our house, and he's swooping quite low."

"Gee, I hope he doesn't scare Mom," commented the boy. "She's pregnant, you know."

* * *

A salesman for a building supplies house landed in a country town. Noticing an old lady sitting in a chair by a window and staring out at the village scene, he figured there might be a sale.

"I've been noticing you," he said, when he got her attention. "I'm a salesman. Thought I might sell you one of the new double-size picture windows."

"Picture windows?" the old lady grinned, "What fur? I ain't nothin' to look at any more."

Two drunks were leaning over a bar telling intimate stories of their life. "I weighed only a pound when I was born," said one.

"Only a pound! Did you live?" asked the other.

"Did I? You should see me now!"

* * *

The D. P., being new on this side of the ocean, fell victim of American salesmanship and found himself owning a new suit, with two pairs of pants. First time he donned the outfit, his landlord remarked, "Hey, isn't that a new suit you got on?"

"Yah," replied the immigrant, "I'm what you call 'taken in'. In dis warm weather, two pairs pants too hot."

* * *

"Willie," remonstrated the teacher, "you shouldn't talk like that to your playmate. Had you ever thought of heaping coals of fire on his head?"

"Nope," admitted Willie. "But it's a peach of an idea!"

* * *

A motorist after being bogged down in the sticky clay of an old deserted Georgia road paid a passing farmer $10 to pull him out with a team of mules.

After he was on the road again he remarked to the farmer, "I should think that at that price you'd be pulling people out of this stuff day and night."

"Nope," drawled the farmer. "At night's when I tote the water for the holes."

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